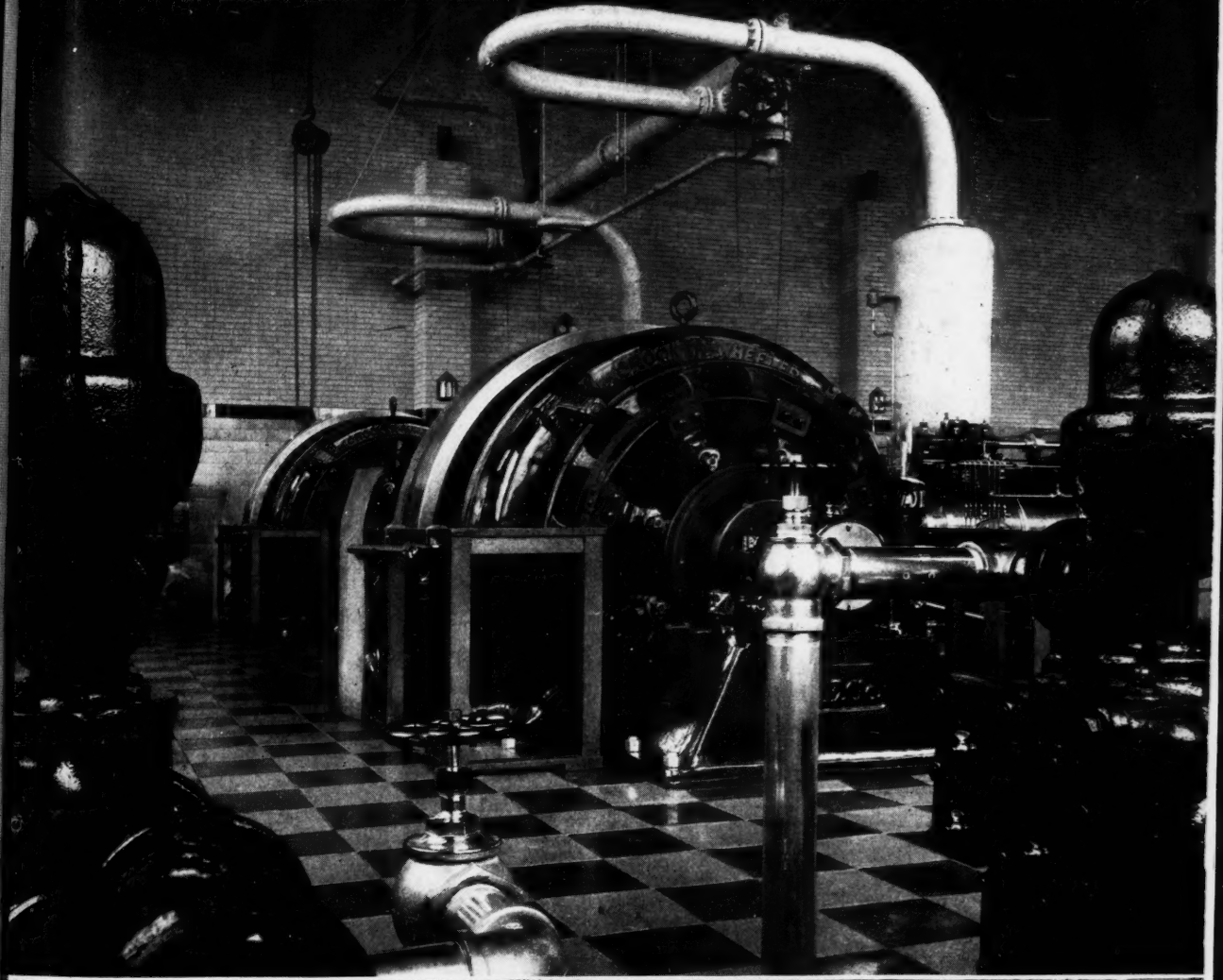
POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



TECHNOLOGY DEPT.

Power Supply For Geneva Steel Plant
Treating Process Water For Wright Aeronautical
High Interrupting Capacity Fuses
Power Plant Extension At Iowa Falls
Governing Extraction Turbines

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JULY 1944

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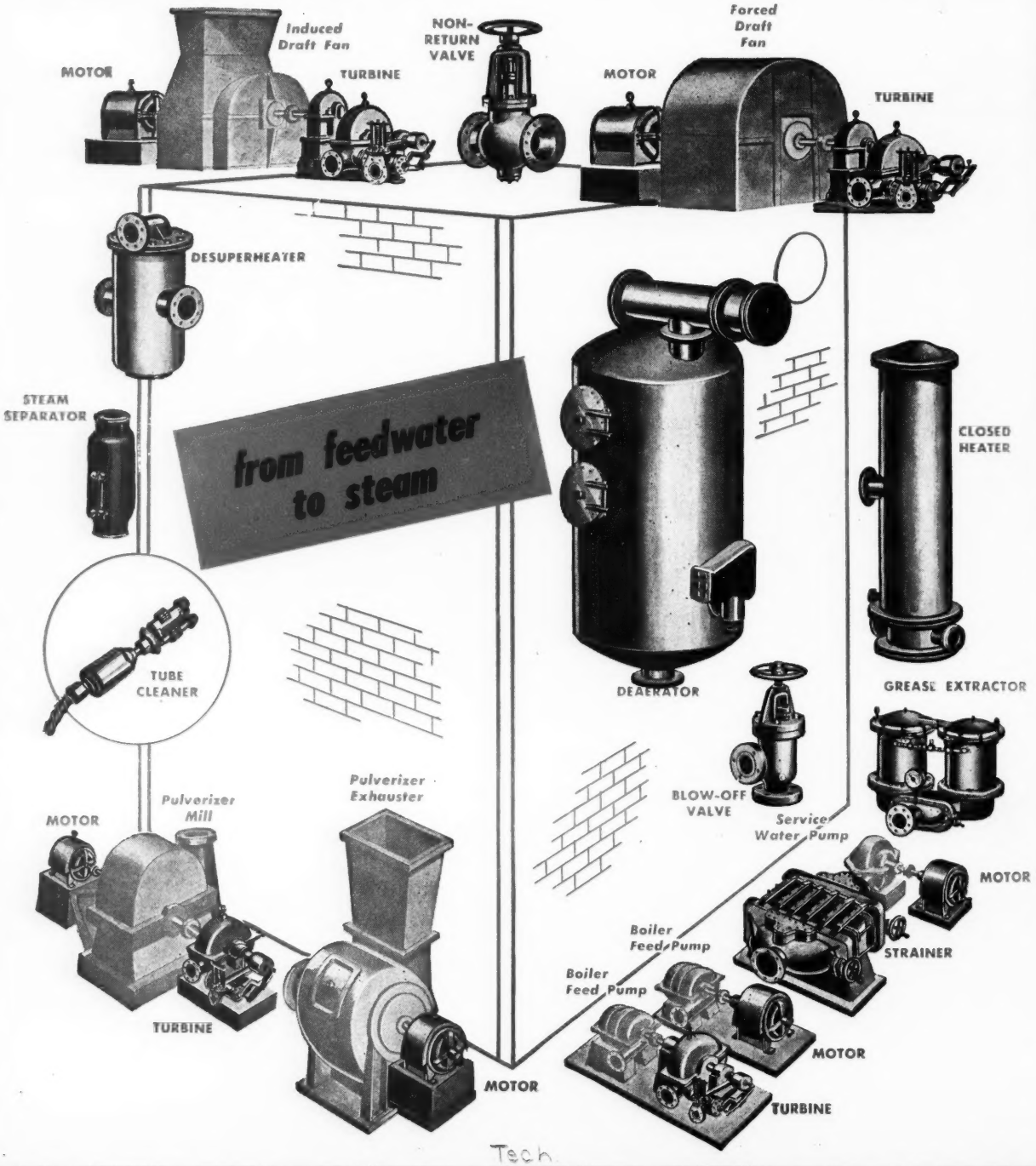
ELLIOTT -- from boiler f



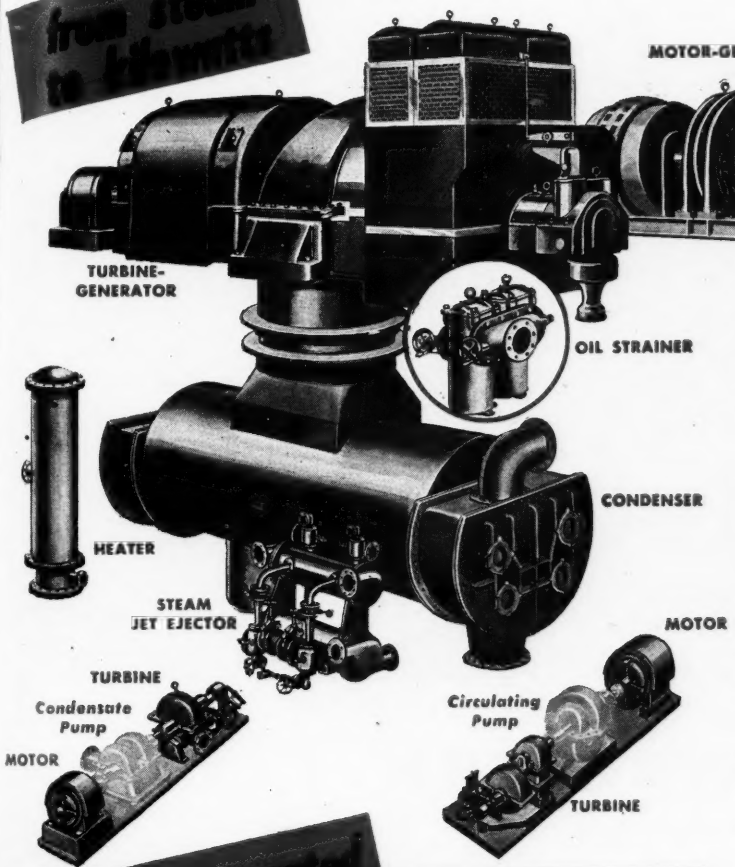
Tech

ELLIOTT

TECHNOLOGY DEPT.

feed to generated power

from steam to kilowatts



Diesel-generated power

On these two pages we picturize the varied equipment essential to put power-on-the-line. There's a lot of it — and a surprisingly large number of these units, (shown in full tone) is being built by Elliott Company.

Some of this equipment, the smaller units particularly, is pretty well standardized, being built on Elliott designs developed through years of practical service. Some, however, such as turbines, generators, larger motors, etc., are designed and built for the specific conditions under which they must operate. How well these conditions are met is attested by the confidence of power plant engineers in equipment with the Elliott mark.

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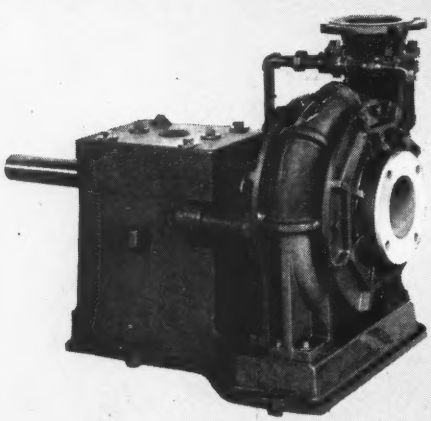
AWARDED MEDAL OF MERIT BY THE FRANKLIN INSTITUTE



The Franklin Institute of the State of Pennsylvania was founded in 1824 and is the oldest institution in the United States for the Advancement of Science and the Promotion of the Mechanic Arts. Annually, since 1890 the Institute has awarded the Edward Longstreth Medal of Merit for Invention. The list of inventors and inventions so honored contains many world-famous names which you would instantly recognize . . . This year the award was bestowed for the invention of Hydroseal. The actual citation from the Institute reads as follows: "In consideration of the development of a pump (Hydroseal) which will successfully handle water or liquids, containing abrasive materials, retain its initial efficiency and original discharge for considerable periods, with low maintenance costs and the successful manufacture of this type of pump (Hydroseal) giving satisfactory operation in many installations" . . . If you'd like to know more about the Hydroseal Pump, write for Catalog No. 140.

HYDROSEAL PUMPS

SAND AND SLURRY TYPES — *MAXIMIX PROTECTED*

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FRONT LINES

NOT LONG AGO, in an advertisement showing one of those rosy-hue dreams of the refrigerator of the future, was pictured a new type of unit with a transparent case through which you could see how much or how little food you had left, but the main feature was alleged to be a set of revolving shelves. Shucks, that's not new at all. Some 40 years ago, in the big farm kitchen of our sainted Aunt Josephine, who had to feed eight hungry children besides two or three ravenous farm hands, stood an enormous refrigerator built of quartered oak and cork in the shape of a perfect cylinder. Inside that refrigerator, all the shelves were supported on a central spindle so that they could be revolved towards the door for easy removal of the comestibles. In later years, on our knees before the conventional apartment house refrigerator, struggling to get the oranges out from behind the butter and the gingerale and the milk and the jelly, without producing some sort of a ground glass cocktail, we have often wondered why the electric refrigerator manufacturers overlooked the revolving shelf idea. It certainly isn't possible that they didn't know about it. It probably wouldn't fit in to the mass production process very well at the time. However, we suspect that even 40 yr ago it was not a new invention. Probably it was invented several centuries ago by one Leonardo di Vinci, in whose notebook you will find sketches of practically everything that we think we have discovered today, except radio. Also, it is quite likely that even he didn't discover the idea but that it goes way back to the ancient Hindus or Egyptians or Chinese. *There* would be a swell subject for a Ph.D. thesis.

SOONER OR LATER in the post war era, somebody is going to take advantage of some of the things that are now being learned in the operation of the famous V-mail service, particularly in the use of micro-film. For example, is there any possibility that some micro-film technique can be worked out for handling ordinary business correspondence? If it could, think of the time and manpower that would be saved. Whether we could do anything worth while with the time after saving it is another problem. (That is something engineers are always up against. Everything they create can be used either by a good man for some good purpose or by an evil man for some evil purpose.) There is, however, another use of micro-film that is actually being made now and that is worth thinking about. It is now being used in a special service, originally established at the Library of Congress in Washington, in which micro-film negatives are made of the pages of very long and extremely technical and scientific manuscript, works which in themselves are of the highest importance, yet are of only rather limited interest to small numbers of specialists and for that reason would not justify publication even in highly scientific magazines because of their bulk. Arrangements can be made to have such manuscripts photographed and properly indexed and then a magazine can publish a very brief abstract telling what ground the paper covers. Reading this, a specialist can decide whether or not the paper is of sufficient importance to him to read the whole thing. If so, he can order a set of prints from the micro-film service or a micro-print to be read by means of a micro-film reading device. The cost of all this, in proportion to its tremendous scientific importance, is relatively low. Some day somebody is going to publish a magazine by that method. He will set up and print, in some way, possibly on a special typewriter, one copy of his magazine. He will then photograph it on micro-film and the reader of the magazine, instead of getting a copy of the issue, will get an abstract of it; he will have a micro-film reading device; he will select the portions of the magazine, as indicated by the abstracts, that seem of most importance to him; and those will be printed and sent to him. By that time somebody will have developed a television magazine so the inventor of the micro-film magazine will promptly go broke and jump out a 28th story window.

TO THOSE AMONG US who have sensed for years that the various social crises we have faced are merely the outward symptoms of a more deadly moral crisis, the following comments from a speech by Eric A. Johnston, President of the Chamber of Commerce of the United States, before the Council of Social Agencies, is significant: "But, there is this difference between ourselves and our totalitarian enemies across the Pacific and across the Atlantic; they look upon war as the normal and desirable state of affairs; we look upon it as a tragic and hateful interruption of the normal and desirable way of life * * * The danger that we must guard against is that the enemies' moral corruption may touch our blood stream. Even where we are forced to use their methods, we must not allow their attitudes to pollute our philosophy of life * * * The two decades between the two World Wars have been a period of cynicism and little faith. But these things have not been confined within the frontiers of the totalitarian countries. Even among us in America there have been alarming symptoms of moral decline. During these decades it became 'smart' to question moral values, to 'debunk' everything, to rationalize brutality, to make excuses for horrors at home and abroad. We have heard men sneer at freedom and make light of democracy. A lot of us forgot that our code of morals, our respect for truth and fair dealing, are not arbitrary laws imposed from the outside * * * To the extent that we have yielded to the wave of cynicism we have contributed to the great crisis of this epoch, now culminated in the most destructive war of all time. The fact is that it has been not merely a political or economic crisis. It has been a crisis in morals. An evil wind has blown through the world and the havoc it has wrought is now all around us."

NOW THAT we are all having trouble with laundries—and if you don't believe we are, just listen to the radio comedians, for the radio jokes reveal the salient characteristics of our civilization—it seems to be a good time for somebody to investigate scientifically the whole process of washing things. Perhaps some fine day, when you are allowed to buy a new washing machine, this information would enable you to look at a "white" shirt with a less jaundiced eye. As a matter of fact, the Westinghouse research people are now doing some work on washing, particularly on the influence of rinsing. They find that after a hundred careful washings a white shirt may contain 50 times as many unremoved solids as it did after the initial washing. This process of rinsing has been the most neglected phase of the washing operation to date.

THE ARMY'S typhus preventive, DDT, promises to be the most effective general insecticide found to date. First synthesized in Europe in 1874, DDT was proposed as an insecticide in 1940 by a Swiss concern, Geigy and Company. Early last year it become the subject of intensive study by the U. S. Department of Agriculture. Published results of this work and actual experience indicate that DDT will have a far-reaching effect in the control of household pests, agricultural enemies and disease-spreading insects. According to Brigadier General Stanhope Bayne-Jones, Chairman of the United States Army Typhus Commission, DDT may even affect the history of the world by averting customary war and postwar typhus epidemics. Some indication of this was given recently when the dusting of 1,300,000 Neapolitans with DDT cut the new typhus cases from 60 to 10 a day, thus checking a dangerous epidemic. DDT is a whitish, odorless powder, insoluble in water, but readily dissolved in alcohol and acetone. It is a synthetic organic chemical, technically known as dichloro-diphenyl-trichloroethane. Although, like all insecticides, commercially effective only against certain insects, it is astonishingly potent against many species. Most important feature of DDT is its long life. Another advantage is its simple chemical structure, permitting production by a straightforward process from common chemicals. This aspect is of especial significance now when Far Eastern sources of pyrethrum and rotenone are no longer available.

DURING the past few months we have been doing a little thinking—and we want to hear no more wise cracks from the rear seats about how that is all we are capable of—about the possible future relations between all the types of fuels we now have available and the future trends in power plant design which will obviously be influenced most by what fuel we shall be able to burn and how we shall be able to burn it. For example, if we are going to run short of oil in this country it will be necessary to develop a coal burning gas turbine if the gas turbine is to be a successful prime mover in the future. But within the past few months there has been a flurry of interest in some of the Canadian petroleum developments. Something may be afoot in the Fort McMurray section in Canada. There is a report of oil discoveries in Mississippi, there are great plans afoot for developing the oil resources of Venezuela and other parts of South America which have hardly been touched and there is a great deal of debate about the proposed oil pipe line to be built by American interests co-operating with the government in Arabia, which will make oil available although not readily accessible. For example, if there should be another wave of oil discoveries all over this country, as there was in the 20's, just when we warned that we were getting short of oil then it may not be necessary for us to think about large scale preparations to produce oil from coal. Turning now to coal there are some investigations now underway on entirely new methods of burning coal which, if successful, will change a great many of the factors in power plant design and operation. Looking down another road, some people are giving a little thought to the possibility of treating coal at the mines to produce various chemicals and gases which would be piped around the country through our existing tremendous pipe line system and the gas turbine might be a very logical prime mover to furnish power for such coal treatment plants because one of the principal reasons why power and other types of plants cannot be located close to coal mines is the lack of water for condensing and other purposes. But if gases from coal treatment can be piped around the country, so can natural gas as our existing network of natural gas pipe lines attests. Shall gas be considered a chemical agent, shall it be used as fuel for gas turbines or steam power plants, is the use of diesel engines that can be converted to burn gas going to increase and what are their best possibilities, and so on and on far into the night. It seems to us that in thinking about any one factor in the entire subject of fuel you have got to think about all the other potential fuels as well and the relation of all of them to the methods of extracting energy from them. All these things are in turn related to the development of our water systems, for flood control irrigation and power development. A specialist in any one of those factors may know a great deal about that particular factor but we have not found very many of them that have attempted to see the overall picture. We do not claim that we see it ourselves, but at least we feel that there is one. We are attempting some outline of it now and hope to have it ready for presentation in the future.

TYPICAL STUFFED-SHIRT conversation heard in Pullman smoking compartments, restaurants, saloon—er, taverns, and other places where elbows are bent; "I tell you, Bill, we're going to see things done a lot different after this war than they were before. Why, look at all the things they're doing with plastics and radar and everything like that." Then Bill rattles the ice in his glass a while and replies: "Well, now, Joe, I don't know; you know how people are—awful slow to take to new things. And another thing—don't forget all these things you see in the ads tell you how well these new gadgets are going to work but they don't tell you about all the bugs that's in 'em and all the things that go wrong with 'em and how much they cost." Which all goes to prove that an expert is correctly defined as a salesman far away from the home office.

ONE of the paradoxes of the American industrial system is the fact that while a relatively few very large companies do a very large proportion of the country's business measured in dollars, there in their shadow stand about two million small businesses, employing 45 per cent of all working people. The tendency of the big businesses is to get bigger and more powerful, the ambition of all the small businesses is to get as big as the biggest ones. The war has emphasized the many advantages of bigness and concentration of power; nevertheless, to maintain high employment, we must have the small businesses that provide it. Big businesses can do many things for the welfare of society in general that small businesses cannot do. On the other hand, there is a type of individual that works best in the small business. It is significant that a great many of the young men now in the service allege that their principal ambition when they get out is to get into a business of their own or to own a small farm. This is quite natural, when you are wound up in an activity of which you are only a very small part and whose overall purpose and progress you never can understand or visualize. Every fighting man always has that experience. So he looks forward to some organization that he can understand and visualize. However, it is well not to take this attitude too seriously, for it will be affected by many postwar conditions. The paradox, however, must be either solved or lived with. In any case it is heartening to see that it is recognized by the appointment of a committee on special problems of small business by the CED, to attempt to do something about it.

WHAT

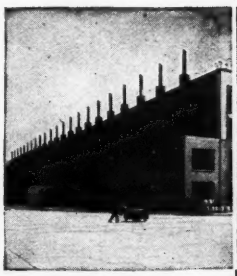
EXHAUST AND INTAKE SILENCERS

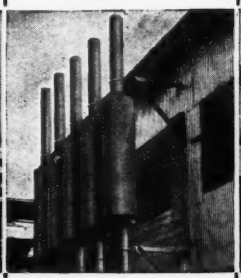
SPARK ARRESTOR SILENCERS

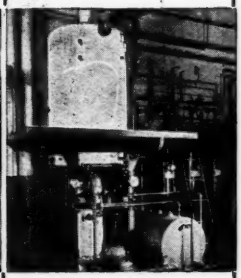
STEAM BLOW-OFF SILENCERS

HEAT RECOVERY SILENCERS

WHERE







WHEN

● These Maxim Silencers are designed to silence the exhaust or intake of internal combustion engines, steam engine exhausts, air compressor intakes, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements.

● Maxim Spark Arrestor Silencers effectively silence exhaust noise and in addition provide for 100% trapping of all sparks and embers which might come from the exhaust. Of obvious value in marine use, these Spark Arrestors are also applicable to industrial use where a fire hazard exists.

● These silencers were developed for use on installations involving the discharge of high velocity steam, air or gas to atmosphere. Used for steam blow-off, safety valve discharges, etc. Silencers shown above installed on high velocity steam exhaust have a total capacity of 135,000 lbs. per hour.

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BULLETINS: D105 and D33.

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ARMY E NAVY

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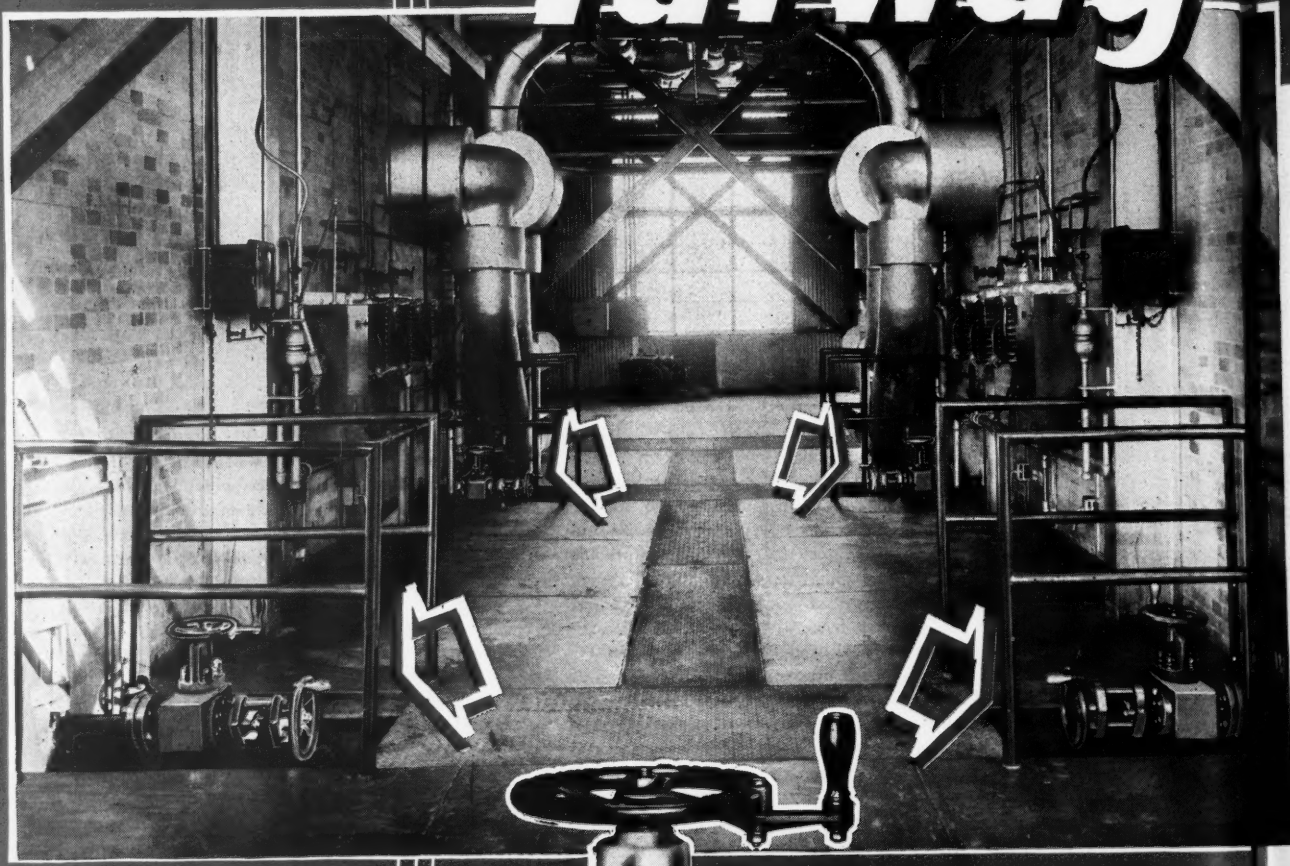
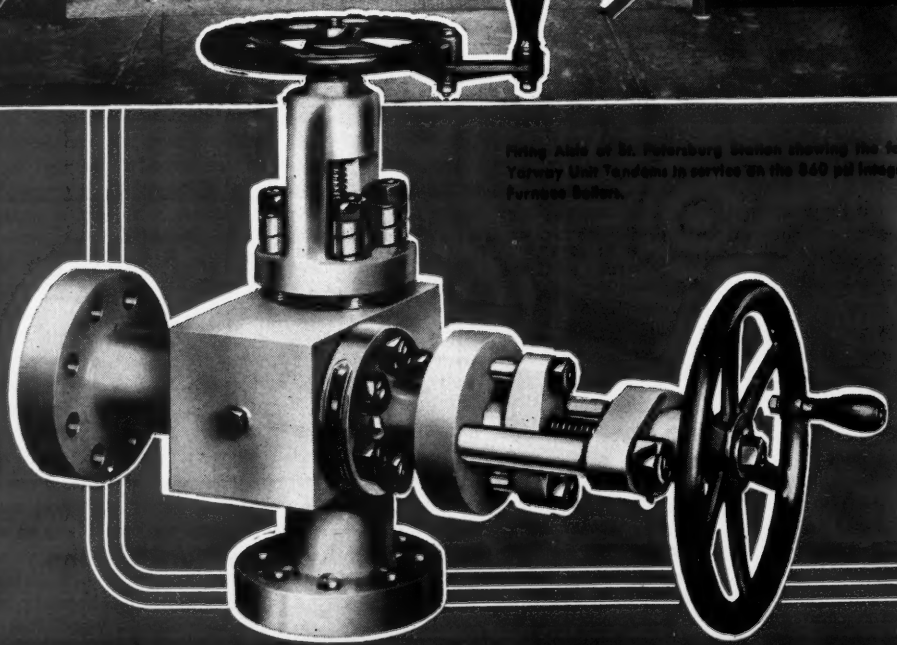
Yarway



Firing Aisle of St. Petersburg Station showing the four Yarway Unit Tandems in service on the 860 psi Integral Furnace Boilers.

Yarway Unit Tandems are built for pressures up to 2500 lb. Combining the Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or draining and sealing—in a compact, rugged unit.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve with special Stellited seat and disc and other features which greatly reduce wear in this type of valve. Outside sealing valve is the famous Yarway Seatless design. This valve is always opened first and closed last, maintaining a tight seal.



YARWAY

at "St. Pete"

Florida Power Corporation is 18 Year User of Yarway Blow-Off Valves at Both Inglis and St. Petersburg Steam Stations

The proof of any product can be found in the long experience of its users.

Way back in the early "twenties", the Florida Power Corporation started purchasing Yarway Blow-Off Valves for both the Inglis and St. Petersburg Stations—built to operate at approximately 350 lb pressure.

Years of satisfaction with these valves prompted the selection of the four Unit Tandems, illustrated, for the two recently installed 860 lb, 910° F. Integral Furnace Boilers at St. Petersburg Station.

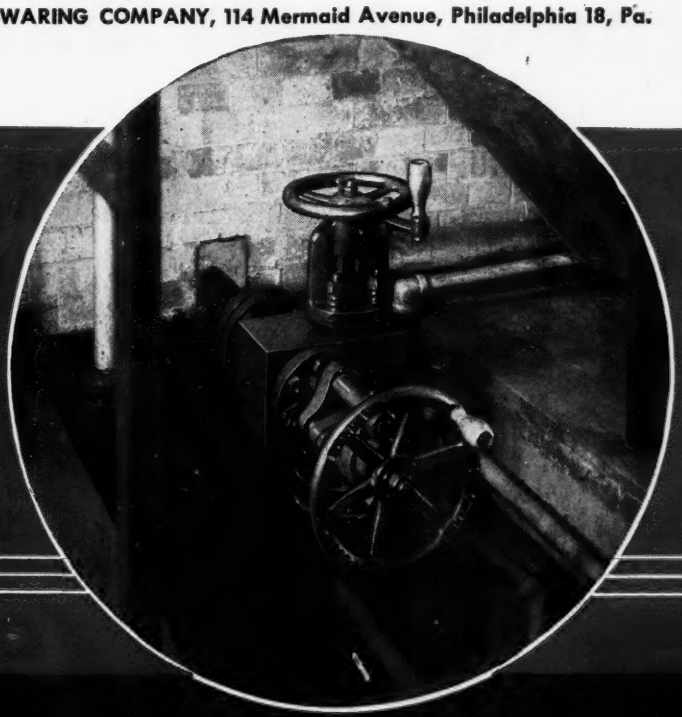
Another in the long list of modern, high pressure generating stations to select Yarway Unit Tandems for both water-wall drains and main boiler blow-down lines.

Yarway Unit Tandems, built for pressures up to 2500 lb, combine a Hard-Seat and a Seatless Valve in a single, one piece forged-steel body. This Tandem provides the advantages of both valve designs—for blowing or draining and sealing—in a single, compact, rugged unit, the result of more than a quarter century of mechanical and metallurgical research and field experience.

For high or low pressure blow-down service, users say, "You can't do better than buy Yarways."

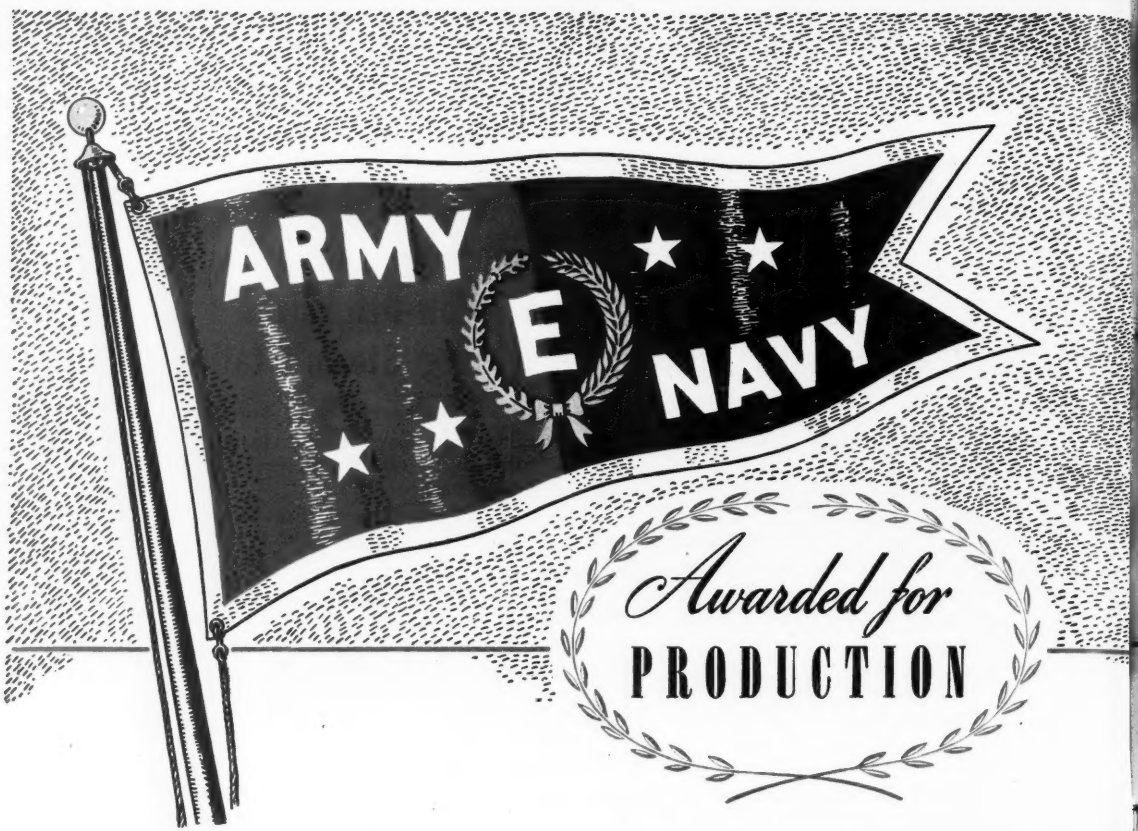
Write for Catalog, Section B-431 for pressures from 400 lb to 2500 lb. Section B-424 for lower pressures.

YARNALL-WARING COMPANY, 114 Mermaid Avenue, Philadelphia 18, Pa.



Close-up of one of the four Yarway Unit Tandem Blow-Off Valves, Fig. No. 3982-3958, at St. Petersburg Station.

BLOW-OFF VALVES



Highest Army and Navy A

For the fifth time Foster Wheeler's Carteret Works has been awarded the Army-Navy "E" for excellence in production. Working to the exacting standards of Navy inspection, the shops are turning out unprecedented quantities of equipment.

- ★ **Steam Generators, Condensers and Distillers for the Navy, Maritime Commission and our Allies.**
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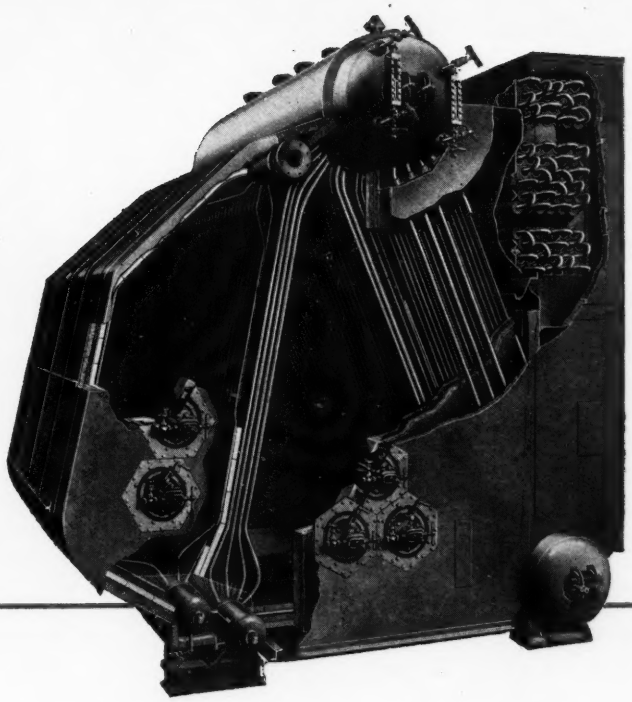

y Award to Foster Wheeler

The marine separately-fired superheater type steam generator, engineered and developed by Foster Wheeler, is standard equipment on naval combat ships. This design proved an influential factor in the development of stationary boilers incorporating the separately-fired superheater furnace principle and culminating in the Twin Furnace Steam Generator.

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WHEELER FW

Backing up the field engineer is a staff of Hall water specialists whose combined knowledge has helped to solve the toughest problems of scale, corrosion, silica deposition, carryover, embrittlement and numerous other boiler ills.

6 years of unfailing power. The Hall Field Service Engineer has just finished his periodic inspection of an old boiler which has been kept in service continuously—without forced shut-downs—for six years. This is the kind of service you can expect from Hall preventive care.

HALL SYSTEM
of Boiler Water Conditioning

How HALL "Preventive Care" gives new life to old boilers

MANY a power plant engineer is fondly nursing boiler equipment these days which only a few years back seemed to have earned deserved retirement.

One thing alone is responsible for the valiant performance of these "old-timers" —the progress that science has made in keeping a boiler "fit" and on the job— the knowledge that has enabled these plants to put their boilers in shape and *keep them there.*

Contributing mightily to this highly important result has been Hall preventive care —a service that includes everything needful, from the original diagnosis which detects the origin of boiler problems to the remedies and supervision which prevent them from occurring again.

Important in these operations is the personal assistance of the Hall field engineer. Most important, too, is the complete support of the finest equipped and staffed laboratories in the world devoted exclusively to research in and the solution of water conditioning problems.

No longer need you worry over the destructive inroads of scale, corrosion, embrittlement and carryover, the constant deterioration arising from water conditions. In thousands of plants the modern practice of preventive care is keeping them under control. It could do as much for yours.

For more than 20 years Hall scientists have been the authoritative leaders in the field of boiler water conditioning. Out of this experience and through their research has come a system of preventive care which is standard practice in important power stations throughout the nation. May we tell you more about it? We'll gladly send complete information or a Hall representative.

HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH 30, PA.

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Hall Service in a Nutshell:

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. **Minimizes boiler outages caused by water.**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water.**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

NO OTHER

Gives You All Three Benefits

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Lubricants

GARGOYLE D.T.E. Oil 797 was developed to meet the most severe turbine operating conditions resulting from today's increased steam pressures and temperatures. It is now in service in turbines of all sizes. Get the full details on the aristocrat of the famous Gargoyle D.T.E. line from your Socony-Vacuum representative.

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Turbine OIL

1. A superior base stock that is in itself an excellent turbine oil.

2. Added resistance to oxidation that enables this oil to surpass all leading turbine oils in severe tests.

3. Maximum anti-rust qualities for protection against corrosion.

New GARGOYLE D.T.E. OIL

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The TERRY

TERRY
SOLID WHEEL TURBINE
ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

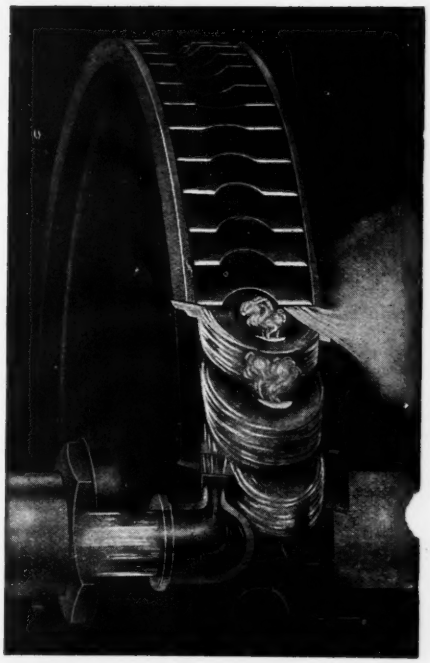
— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

— The Terry wheel will withstand abuse that would wreck any built up wheel.

THE TERRY STEAM TURBINE CO.

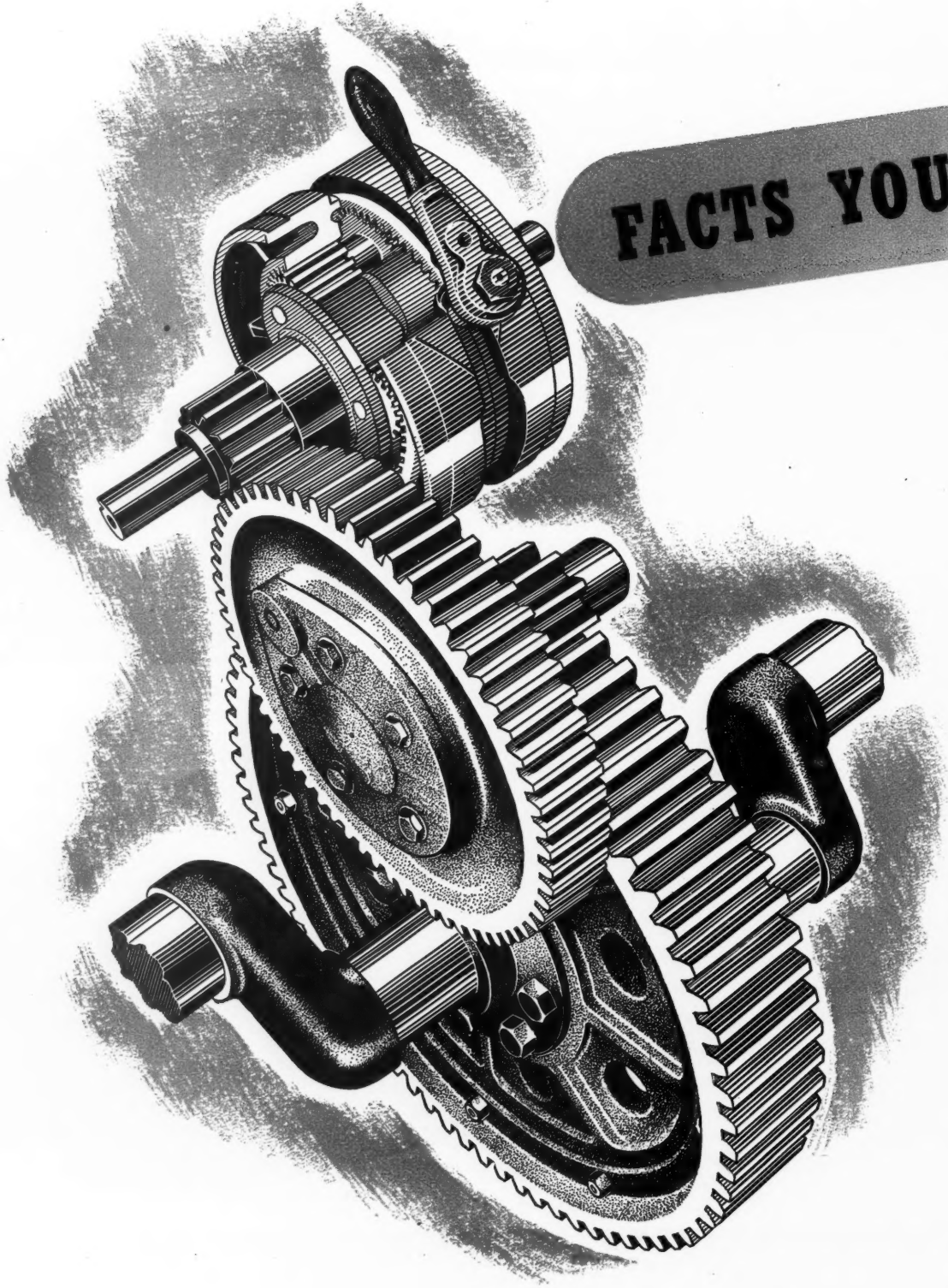
Wheel Turbine



At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized

T-1147

TERRY SQUARE - HARTFORD, CONN.


FACTS YOU

SHOULD KNOW ABOUT THIS—

SPUR GEAR PLANETARY DRIVE

THE TAYLOR STOKER 2-speed Power Box, an all spur-gear planetary transmission, transmits the power to operate the main coal feeding rams, and the fuel distributing members.

It provides two speeds and a neutral position.

Speed changes are made with gears in mesh at all times. No disengagement of gears is required. No clutches, thrust washers, thrust bearings or stuffing boxes are employed in this unique all-spur gear planetary transmission.

Simplified construction results in lower maintenance costs, and more efficient transmission of power.

The spur gear planetary construction now employs a triple gear cage pinion which results in a more balanced drive with minimum wear on the component gears of the entire transmission.

There are 6 other distinct advantages of the Taylor Stoker Power boxes:

1. The entire drive is protected by an easily accessible shearing pin.
2. Outer rim of main gear is renewable, easy and economical to replace.
3. Oil return device keeps oil level in upper casing constant.
4. Bushed bearings.
5. Design permits motor to be mounted right on power box to form a compact driving unit.
6. A steam turbine may be furnished as an integral part of the Taylor Power Box—giving a 10 to 1 speed range.

The Taylor Power Box is only one of numerous features which make the Taylor Stoker advisable for efficient low cost steam generation.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

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HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

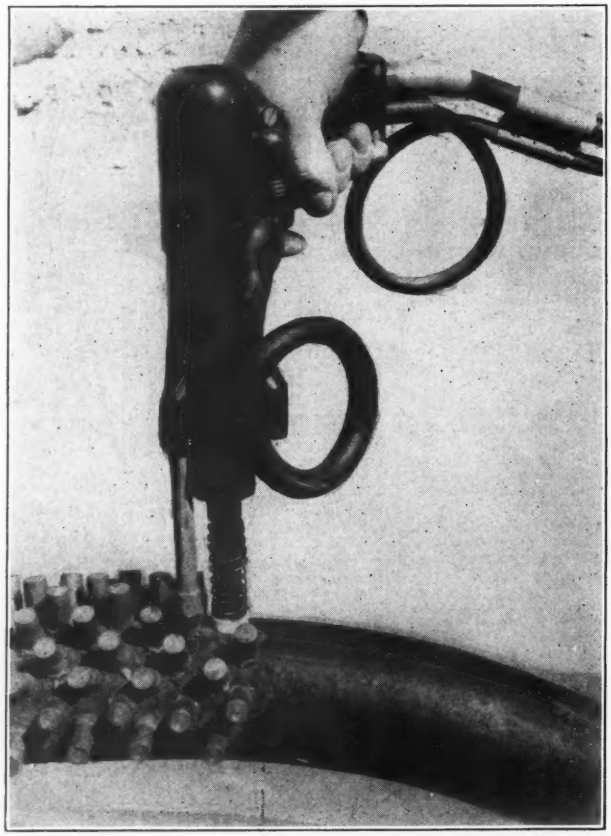
A-E-CO TAYLOR STOKER

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

DAMAGED BOILER TUBES NOW QUICKLY REPAIRED!

★ *Nelson Stud Welder automatically welds studs on boiler tubing in less than 1-2 second!*

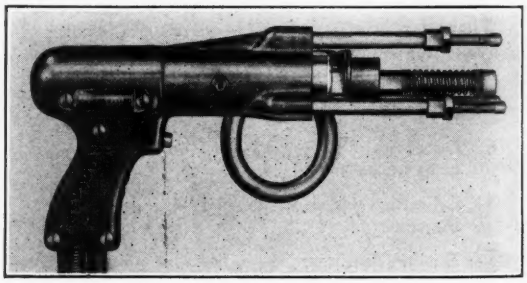


Studs are welded on lines scribed on tube before welding . . . 1¼" apart on 19° centers. The stud is placed in the chuck, the gun positioned, and the trigger pulled to complete the weld. The gun is then reloaded with another stud and the next weld is made.

Using the Nelson Stud Welder two women welders recently welded 13,000 studs on new boiler tubes in 18 hours! One welder and a helper studded an average of 24 feet of tubing in 8 hours! These are not special tests, but time checks made on regular production jobs.

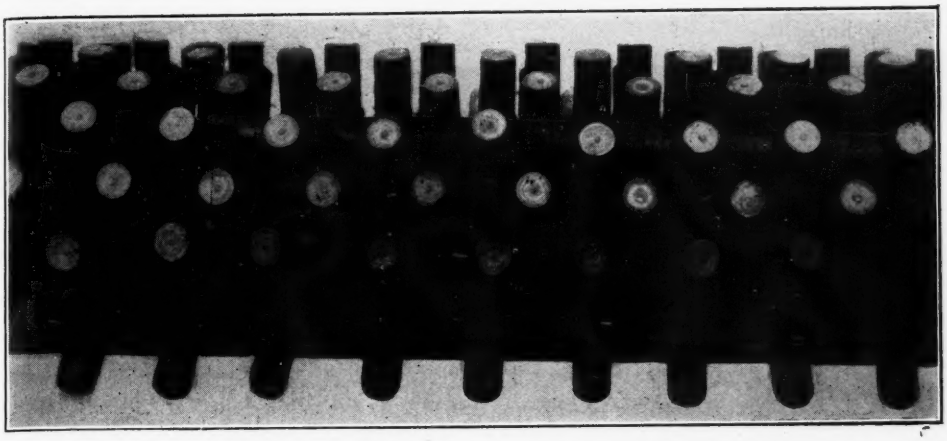
The Nelson Stud Welder will make your boiler maintenance problem easier. No need to have your boiler out of operation for one to three months . . . no need to stock a large inventory of special tubes . . . repair it at your plant.

The accompanying photographs represent a typical installation recently completed for a large power company. Write today for complete details on how you can use the Nelson Stud Welder!

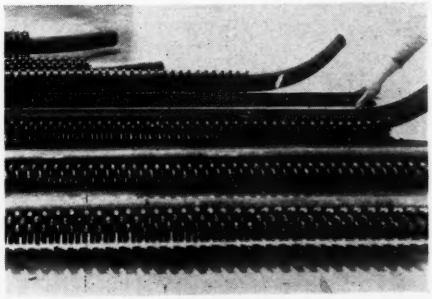


The Nelson Stud Welder is fully automatic and is easy to operate. Proven by 5 years of usage, it is today used in over 300 industries and shipyards throughout the United States and Canada.

THE NELSON ARC



Studs illustrated are ½" dia. x 1⅛" length. The strength of the weld is equal to the strength of the stud. **Complete fusion results between the stud and the tube!**



Perfect alignment of the stud is easily obtainable with this flexible stud welding unit.

CATALOG AND SAMPLES:

sent *free* upon request. Simply drop a card to the address below and complete information will be sent.

Completed tubes demonstrate the uniformity of Nelson Stud Welding. You will find many other uses for this product in your maintenance program. Wherever there is need to end weld studs to metal or secure parts, it may be easily used!

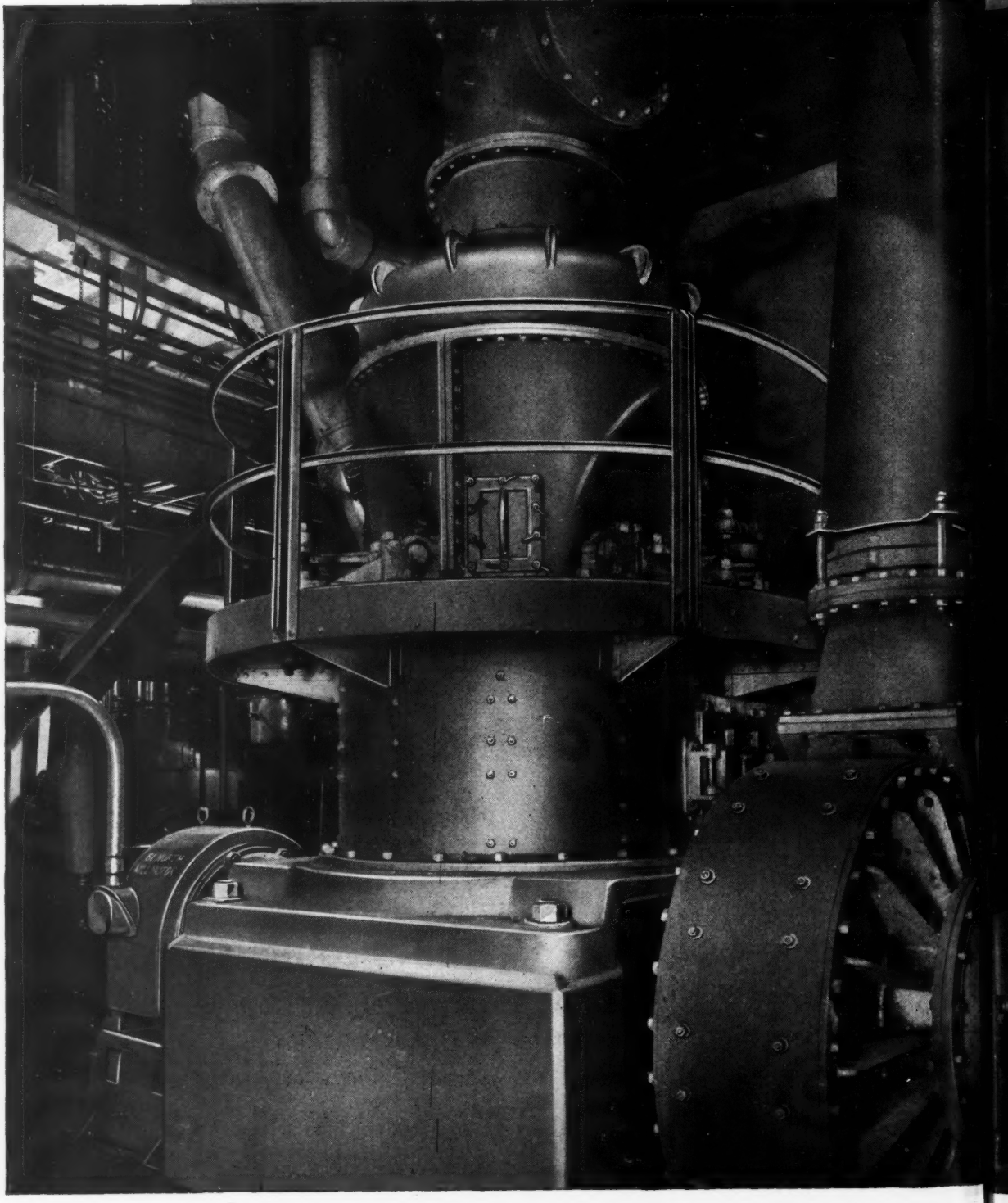
NELSON SPECIALTY WELDING EQUIPMENT CORP.

Dept. P6, 440 Peralta Ave., San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp., Camden, N. J.

STUD WELDER

GRINDING



35,000,000 TONS OF COAL A YEAR!

IMAGINE 35,000,000 tons of coal — or picture 700,000 loaded coal cars stretching from New York to Cairo. Such is the aggregate of the amount of coal we can assume is being pulverized in a single year by all the C-E Raymond Bowl Mills purchased to date. Obviously the figure is an approximation, but a conservative one, since it is based on an average of 5,400 operating hours for each mill — about 60% of the total number of available hours in one year.

This grinding capacity serves to show the remarkable acceptance accorded the C-E Raymond Bowl Mill for pulverized coal fired installations. It is the more remarkable when you remember that the C-E Raymond Bowl Mill was placed on the market only 9 years ago. This is a strikingly brief period of time for a piece of major industrial equipment to win such widespread endorsement. But it's a likely result of the superiority demonstrated by the C-E Raymond Bowl Mill in such desirable qualities as dependability, noiselessness, low power consumption and low maintenance expense. A-784

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Progress and Power in TUNNELS AND SUBWAYS

The progress made by America's great Public Utilities in furnishing low cost power for any and all needs, plus man's ability to conquer distance and time by means of tunnels and subways, marked a new era in the world . . . American Blower engineers contributed to this new age with equipment to handle air . . . In the early days of the New York subways, in the great Moffatt (R.R.) Tunnel near Denver, Colorado, down to the present day portals for the George Washington Bridge (N. Y.), American Blower Tunnel Ventilating Fans have played a vital role. In every job or industry where ventilation is vital to health, comfort and efficiency of people or workers, you'll find American Blower Equipment on the job.

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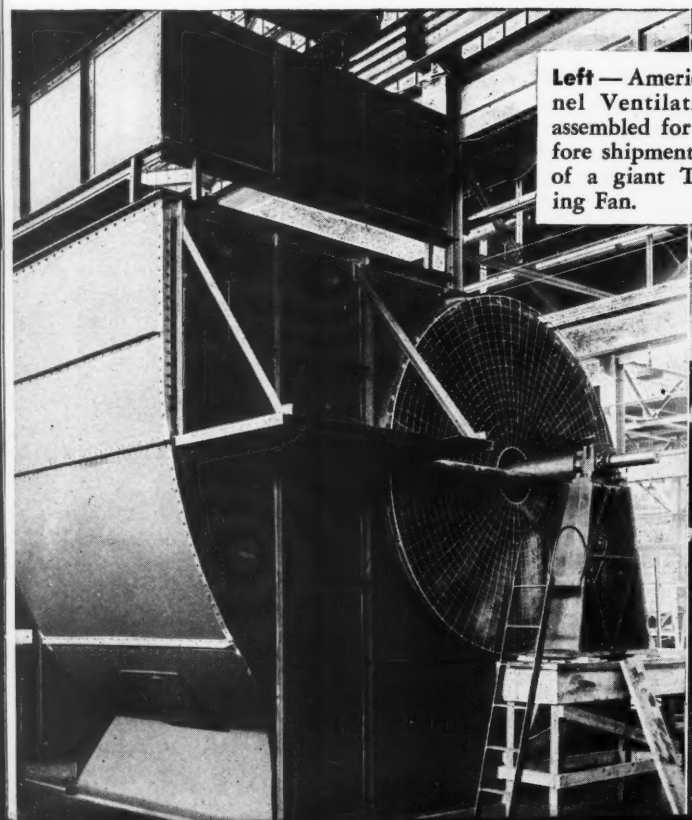
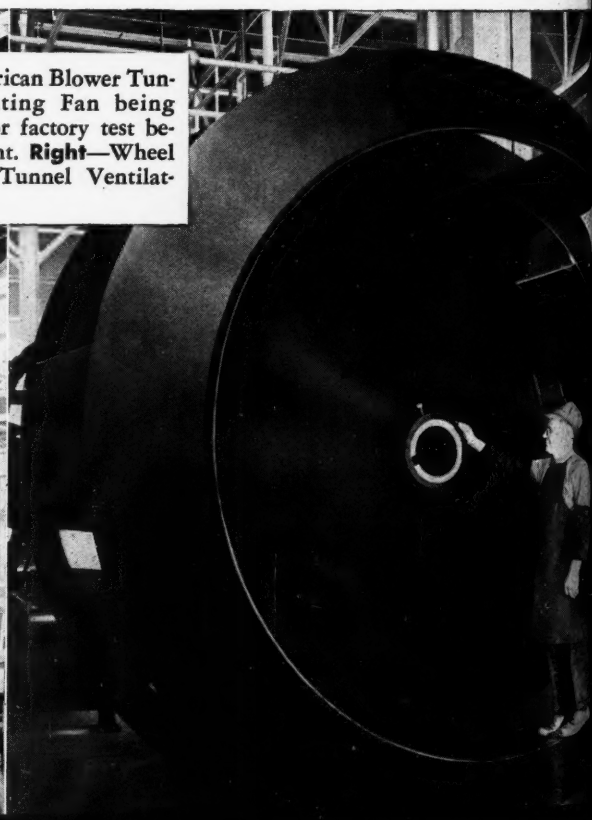
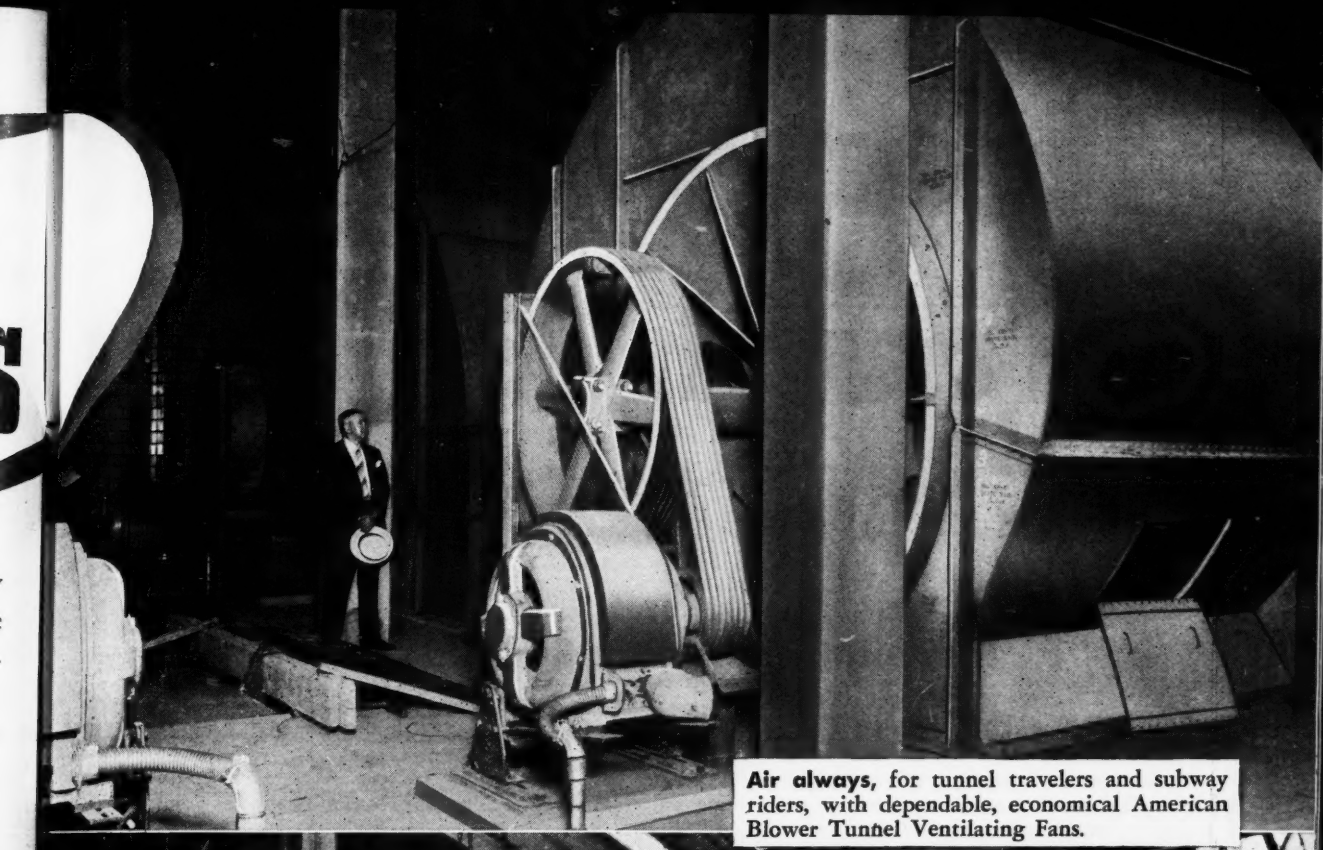




Left — American Blower Tunnel Ventilating Fan being assembled for factory test before shipment. **Right**—Wheel of a giant Tunnel Ventilating Fan.



Air always, for tunnel travelers and subway riders, with dependable, economical American Blower Tunnel Ventilating Fans.

A battery of Tunnel Ventilating Fans on the floor at American Blower assembly plant. Proved design, skillful engineering, pay big dividends in more dependable operation.

Iron Fireman Tough Firing

for instance:

Pneumatic Spreader Stokers Lift Coal 32 ft.—

Save $25,000 First Cost for Hunt-Rankin Leather Company

BECAUSE it operates on the basic principle of floating coal to the fire on a stream of air, the Iron Fireman Pneumatic Spreader stoker has a flexibility of application which reflects remarkable savings in installation costs. These installation cost savings are a plus economy over and above, and in addition to, the widely heralded savings from operation.

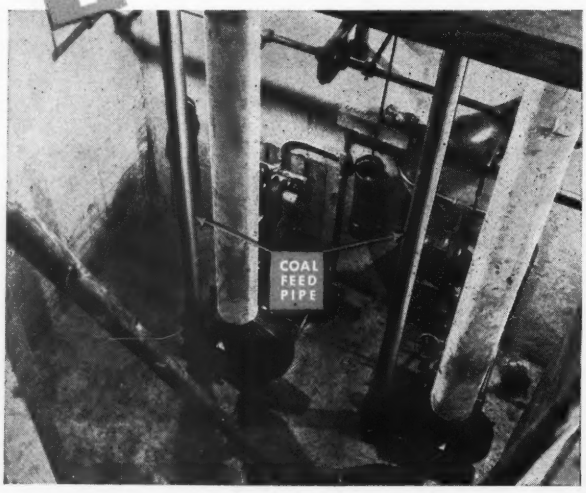
At the Hunt-Rankin Leather Company plant, Peabody, Mass., the job was to convert a plant designed for oil to automatic coal firing. This company faced the necessity of conveying coal to a boiler room at second floor level with the only available coal storage space about 400 feet from the power house. It appeared that overhead bunkers and an extensive conveying system would have to be installed. Iron Fireman found a simple method of obviating this.

Pneumatic Spreader Flexibility Proves Solution

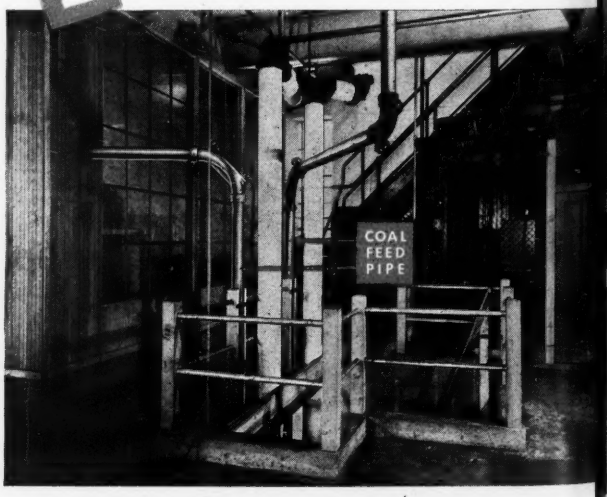
Mr. G. J. Harrington, president of the company, working with Iron Fireman engineers—found the answer in Iron Fireman Pneumatic Spreader stokers, thereby saving an estimated $25,000 in installation costs. Iron Fireman Pneumatic Spreader stokers provide efficient conveying of coal without the expense of installing auxiliary coal handling equipment. They can be set at floor level, on the floor above or below the boiler room level, and at any angle in relation to the boiler front. As shown by the illustrations, in the Hunt-Rankin plant coal is lifted by two bunker-feed stokers from a storage pit, excavated below the first floor level, to the boiler room on the second floor; a vertical distance alone of 32 feet.

THE PHOTOS BELOW AND AT RIGHT SHOW ACTUAL INSTALLATION AT HUNT-RANKIN COMPANY

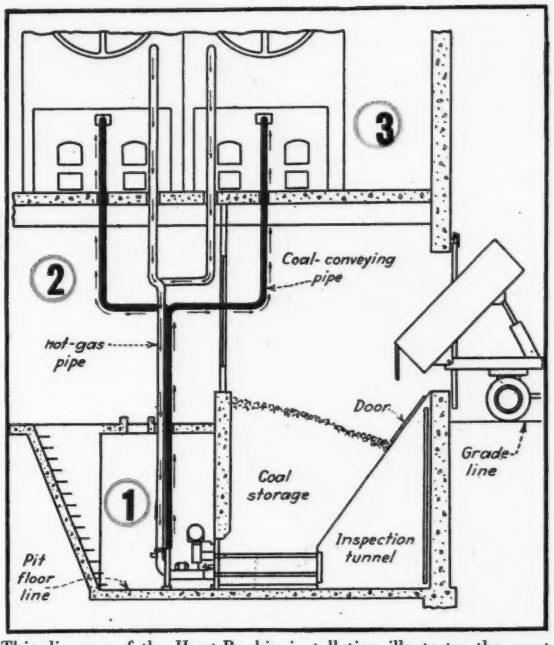
1 **Coal is fed automatically from storage pit into pneumatic conveying pipes.**



2 **Coal feed pipes lift coal vertically 32 feet to boiler room level.**



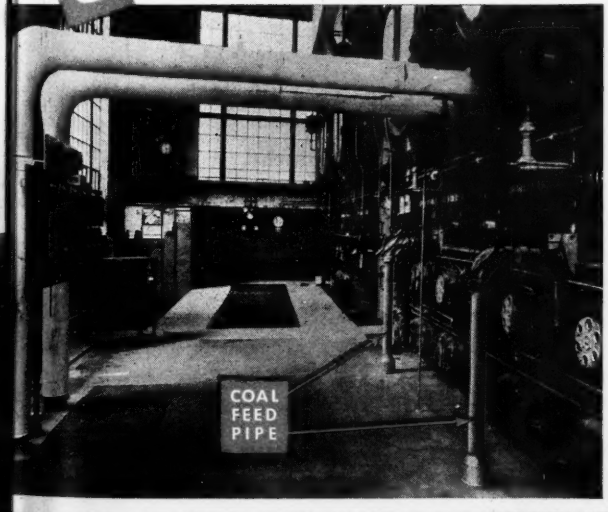
Stokers Handle Jobs . . .



This diagram of the Hunt-Rankin installation illustrates the great flexibility of Iron Fireman Pneumatic Spreader stokers. Here, with coal storage in a pit accessible from grade level, hot-gas and coal conveying pipes lift from feed screws and transfer housings at pit level to boilers on second-floor, a distance of 32 feet. Numbers on diagram correspond to numbered photographs.

73% Boiler Efficiency; Peak Ratings Up to 195% of Normal. Operating 24 hours a day, two boilers carry the normal load at the Hunt-Rankin plant, leaving two in reserve. Operation of these Iron Fireman Pneumatic Spreader stoker fired units shows an overall efficiency of 73% with 13.5% CO_2, and 530-F exit-gas temperature. At operating pressure of 175 psi gage, the evaporation averages 10.8 lb. per lb. of coal. Fuel used is 1¼ in. Pocahontas nut and slack, showing 14,500 Btu per lb. on analysis. The Hunt-Rankin boiler plant has a steam flow varying from Normal to 195% of boiler rating. Despite these severe fluctuations in load, automatic controls maintain desired pressure within close limits.

3 **Coal is distributed over grates by stoker nozzle on coal feed pipes. Note uncluttered boiler front.**



There is an Iron Fireman for Every Industrial Firing Need

To meet the most varied industrial firing requirements, Iron Fireman stokers are available in many sizes and models, including both underfeed and pneumatic spreader types and hopper and bunker-feed models. Iron Fireman engineering assures you the correct stokers for *your* plant, taking into account fuel, load and operating conditions. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Co., 3293 West 106th St., Cleveland 11, Ohio.

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THE IRON FIREMAN

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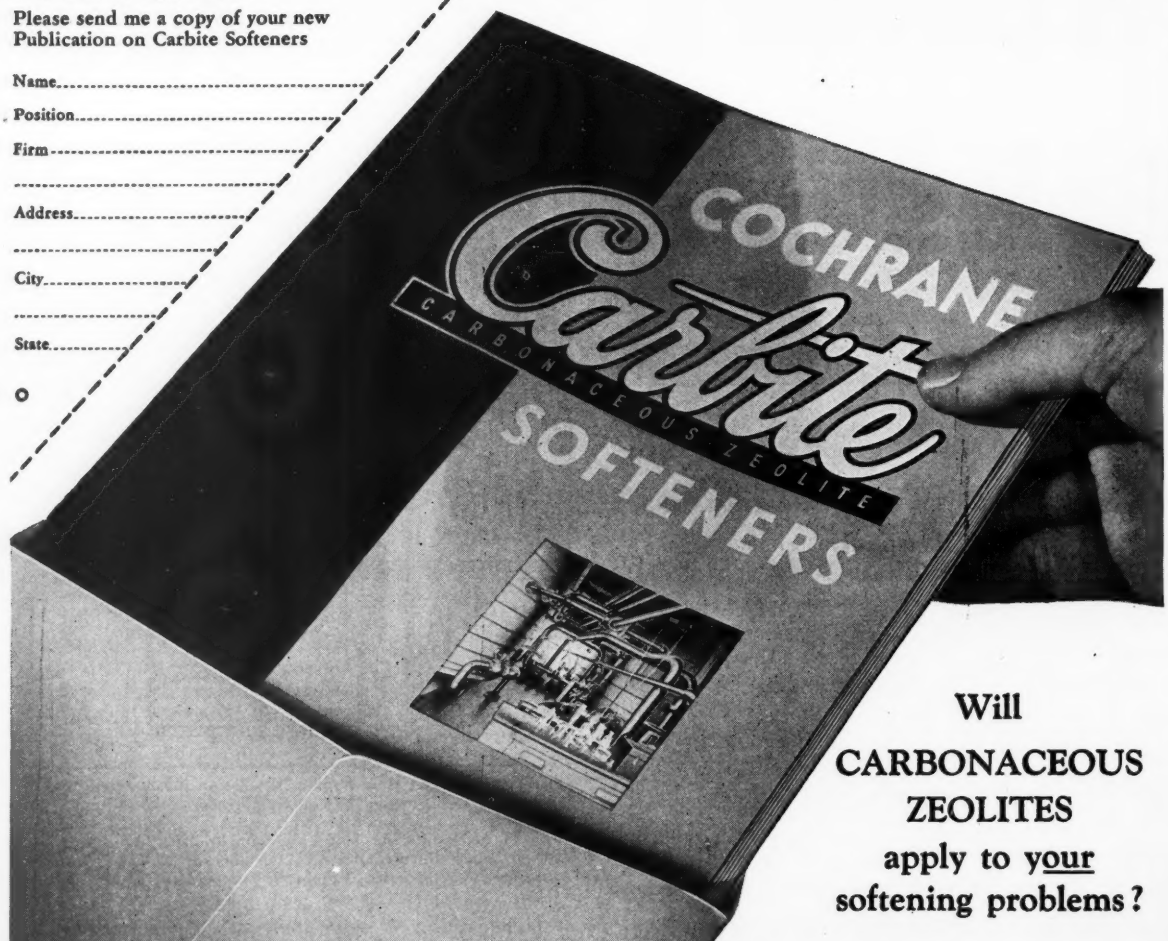

Will CARBONACEOUS ZEOLITES apply to your softening problems?

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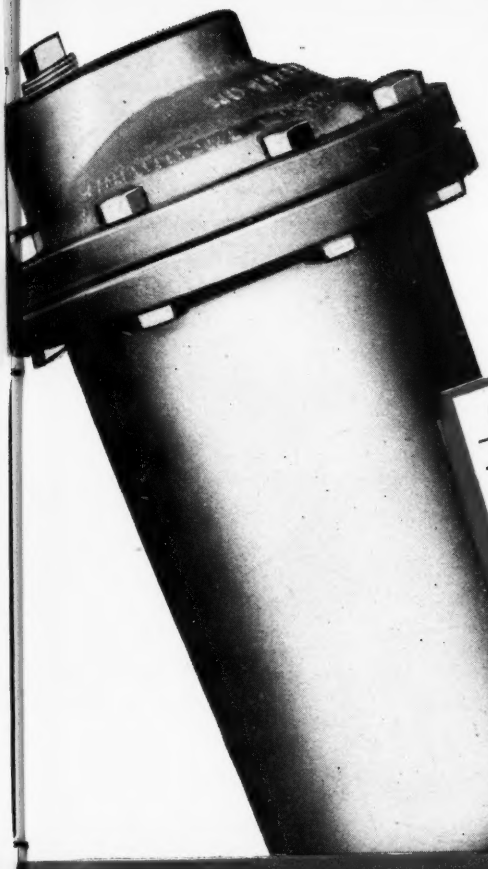


TABLE A

Cost of various sized steam leaks at 100 pounds pressure (assuming steam costs 50 cents per 1000 lbs.)

Size of Orifice	Lb. Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
½"	835,000	$417.50	$5,010.00
3/8"	470,000	235.00	2,820.00
¼"	210,000	105.00	1,260.00
1/8"	52,500	26.25	315.00
1/16"	13,200	6.60	79.20
1/32"	3,400	1.70	20.40

(For steam at 50 pounds pressure, the waste is about 75% of the above figures; at 20 pounds, it is about 50%; and at 5 pounds, the loss is about 25%.)

TABLE B

Temperature reduction caused by air at various pressures.

Gauge Pressure	Temperature of Steam with No Air Present	Temperature of Steam Mixed with Various Amounts of Air. (Per Cent Air by Volume) 10%	20%	30%
10.3	240.1	234.3	228.0	220.9
25.3	267.3	261.0	254.1	246.4
50.3	298.0	291.0	283.5	275.1
75.3	320.3	312.9	304.8	295.9
100.3	338.1	330.3	321.8	312.4

COAL, oil, metal, machinery, mining, manpower, transportation—all critical, and all go into the generation of steam. The most efficient utilization of steam and all that goes into it depends upon having it give up its heat where and when it is supposed to for productive use. Steam traps that remove all air and condensate and don't leak steam are perhaps the biggest single factor in insuring that steam, and all that goes into it, is utilized efficiently.

Air in a steam consuming unit can reduce heat transfer efficiency and steam temperature as shown in Table A. ARMSTRONG TRAPS AUTOMATICALLY VENT AIR AT A RATE OF 7 TO 10 CU. FT. PER HOUR AND 50 TO 100 TIMES FASTER IF EQUIPPED WITH A THERMIC VENT. Air collects at the top of the trap and is discharged along with condensate.

Steam leaks waste tremendous amounts of steam as shown in Table B. ARMSTRONG WATER SEALED TRAP VALVES ARE STEAM TIGHT — HEAT TREATED CHROME STEEL, GROUND AND LAPPED. They are immune to wire drawing and often stay steam tight for 5 or 10 years. They can be reground or replaced after long service in a matter of minutes.

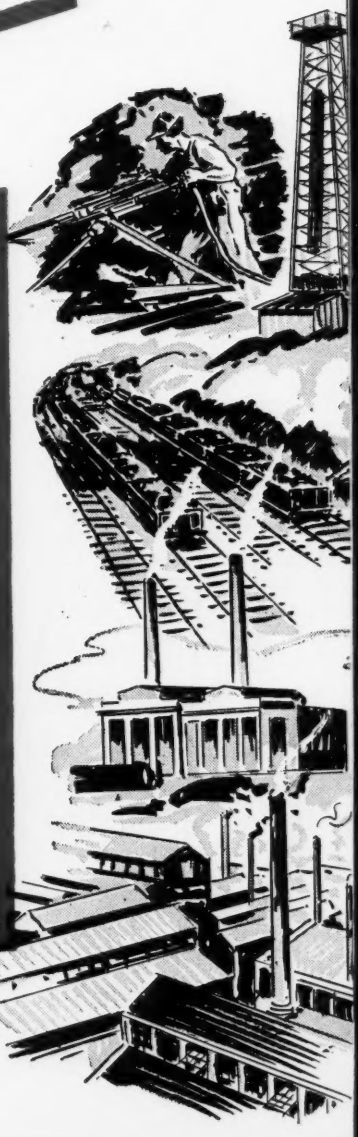
Condensate in a steam consuming unit obviously impedes heating efficiency. ARMSTRONG TRAPS REMOVE CONDENSATE *AT ANY TEMPERATURE* AS FAST AS IT ACCUMULATES. No cooling legs are necessary — no non-productive radiation losses.

It has been estimated that one No. 813 Armstrong Trap would save 10 times its weight in boiler metal and 1000 times its weight in coal annually if it replaced one inefficient drainage device wasting 25 lbs. of steam per hour at 100 psi. And many a plant has many such device.

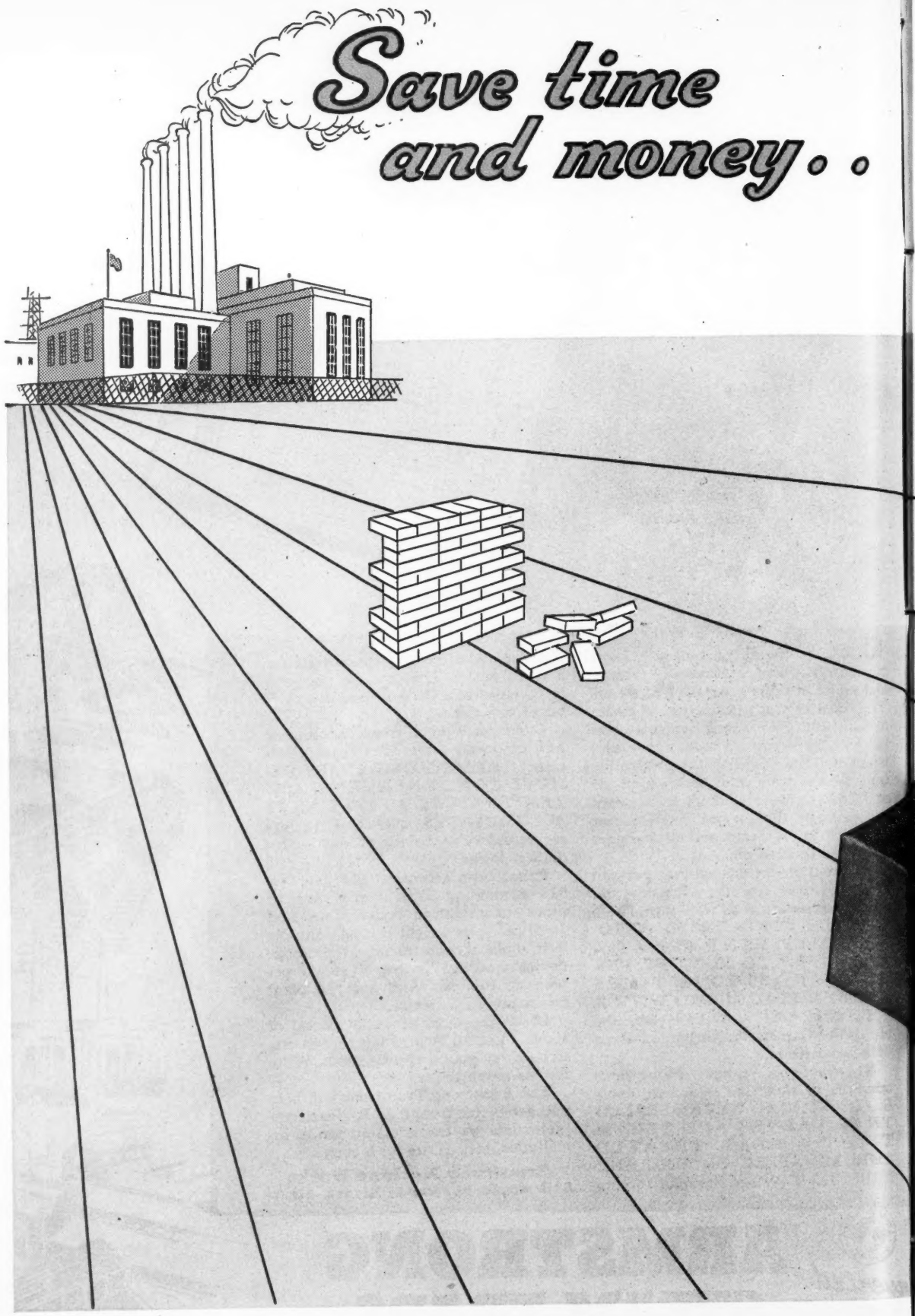
Make the most of every pound of steam. Let an Armstrong representative survey your trapping needs. Write for his name today.

The Armstrong Trap Book will help you get better trapping. It gives complete data on traps, maintenance, installation, etc. Write for a copy.

Armstrong Machine Works
810 Maple St., Three Rivers, Mich.



Inverted Bucket **ARMSTRONG STEAM TRAPS**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THE BRAIDING of the asbestos yarn in Johns-Manville Interlocked Rod Packing is done in a unique and exclusive way. Instead of braiding jacket over jacket, which unravels with wear, the long-fiber asbestos yarn is braided right into the body of the packing and securely interlocked to form a solid, integral structure. Naturally, this means longer packing life and fewer repacking jobs for you!

Furthermore, J-M Interlocked Rod Packing is braided square . . . not braided round and pressed square . . . resulting in a more flexible and resilient packing. This square-section structure presents a better contacting area and provides a tight seal with minimum gland pressure.

J-M Interlocked is now available in a variety of compositions to meet a wide range of operating conditions—such as Nos. 255 and 257 for use against saturated or superheated steam, hot or cold, fresh or salt water, oils and weak caustics or acids, No. 253 for paper stock pumps, No. 259 for gasoline service, and No. 270 for hot oil packing. For more details, write for catalog PK-12A. Johns-Manville, 22 East 40th Street, New York 16, N. Y.

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THERE'S A J-M DISTRIBUTOR NEAR YOU

DUE TO A *Shoestring* PLANT POWER SYSTEM

INACCURACIES that result from eye strain often have an unsuspected *basic* cause—unsuspected because even good lamps and good lighting units can't prevent poor illumination if they are starved for voltage. **DIM LIGHT RESULTING FROM UNDERVOLTAGE** near the ends of long feeders is a familiar symptom of antiquated plant power distribution. At the same time, excessive lamp burnouts because of *overvoltage* may be occurring in areas near the power entrance. **MANY KINDS OF POWER SUPPLY TROUBLE**—affecting production equipment as well as lighting—are likely to be chronic when the plant distribution system has been extended, piecemeal, to handle loads it was never designed to supply. Makeshift switchgear, hand-me-down transformers, and long overloaded feeders may appear to be "getting you by." Until suddenly—like a shoestring—something snaps! Nurse them through for the moment if you must, but start planning now to replace them.

GENERAL ELECTRIC

HERE'S *News*

of modern electric power distribution—G.E.'s load-center system, which you can plan as a complete installation, and install block by block as you modernize or extend your plant.

Heavy feeders **required to carry low-voltage power long distances from the switchboard are eliminated by load-center distribution. With this modern system, power is distributed at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations located near the centers of load areas. There it is stepped down to utilization voltage and distributed to the load through drawout air circuit breakers and *short* secondary feeders.**

ADDS TO THIS VOLTAGE SAG*

*This curve, and those below, are based on an assumed-constant voltage at the plant supply point.

Over to LOAD-CENTER POWER

You can do it a step at a time

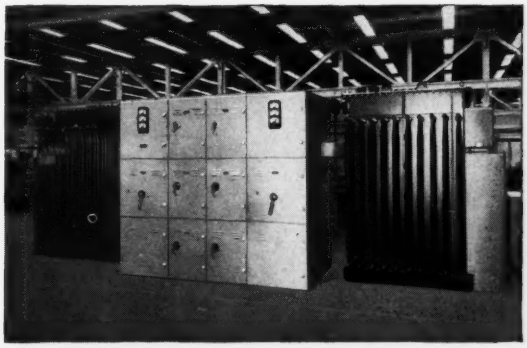
VOLTAGE SAGS, outages, and personnel hazards that are inevitable with outdated power circuits can best be eliminated by the use of load-center unit substations throughout your plant.

The great flexibility of load-center power enables you to make the right start without a complete changeover, all at one time, of your present electric power system.

- *To supply electric power to a new plant extension* requiring 200 kva or more, one or more unit substations can be installed to tie in with future modernization in older areas.
- *To eliminate a "trouble-spot" now served by long, overloaded feeders,* a high-voltage line to a new unit substation at the center of that load area will solve the immediate problem on a long-range basis.
- *To modernize a power system without interfering with production,* you can proceed step-by-step, switching over load areas one by one as more unit substations are installed. Eventually, you'll have the same fully co-ordinated system that would go into a new plant.

Before you make *any* additional investment in transformers, switchgear, or cable for piecemeal extensions or replacements, investigate the load-center system. General Electric engineers will help you decide on a *complete plan* of power-distribution modernization, so that every circuit you add, or every equipment purchase you make from now on, brings you closer to a fully co-ordinated load-center system.

GENERAL ELECTRIC



The load-center power distribution system for this industrial plant called for three double-ended unit substations, with Pyranol transformer sections, each located in a production area.

in Contrast

In contrast to a voltage drop of 10 to 20 per cent which sometimes occurs under full load in long secondary feeders (see chart at top of page), the voltage drop in a well-planned load-center system will seldom exceed 3 to 5 per cent (see below). Here's why: First, voltage drop is minimized by high-voltage distribution. Second, transformer-tap settings at each load-center substation are chosen to furnish full voltage required by the load in the local area. Third, low-voltage feeders are so short that voltage drop is negligible. There is no need to supply excess voltage to assure adequate voltage at the end of a circuit.

L VOLTAGE ALL THROUGH THE PLANT

RUBBER-STAMP ECONOMIES *without* RUBBER-STAMP LIMITATIONS

The G-E unit substation, basic building block of a load-center system, meets *thousands* of user requirements with *relatively few* parts — all repetitively built

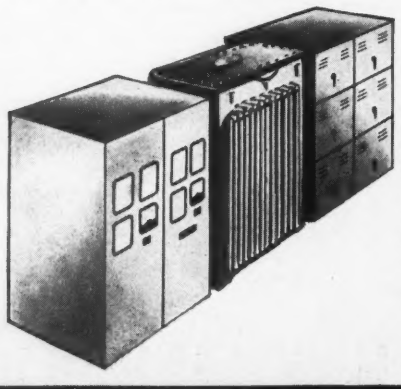
Whatever the power requirements of your plant, or of the load areas within it, G.E. can supply completely co-ordinated unit substations without the extra costs and delays for special design. Whatever the circuit arrangement you choose, a standard combination of incoming-line and secondary protection will meet it. These substations arrive ready to be set in place at the load centers. With a few simple connections, they are ready to go.

They are safely "at home" anywhere in the plant, thanks to the use of a Pyranol* or dry-type transformer section, and fully metal-enclosed switchgear.

In any power distribution system built around G-E unit substations, you can be sure that the interrupting capacity of the breakers is correctly matched to the transformer ratings.

For further information, ask your local G-E representative or write for Bulletin GEA-3758. *General Electric Company, Schenectady 5, N.Y.*

*Reg. U. S. Pat. Off.



The G-E standard-package load-center unit substation includes a safety-enclosed, drawout air circuit breaker equipment properly co-ordinated with a Pyranol transformer. Pyranol transformers, being noninflammable, permit installation indoors without vaults.

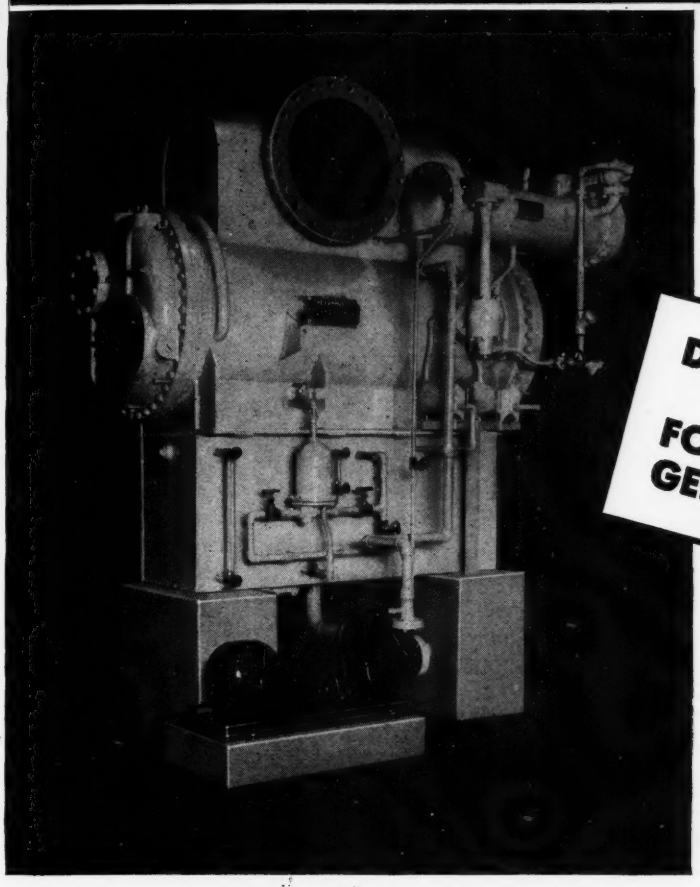
BUY WAR BONDS

LOAD-CENTER Power Distribution Systems

GENERAL ELECTRIC

312-29-5900

1,000 kw package type surface condenser



DESIGNED AND BUILT BY LUMMUS FOR INTERNATIONAL GENERAL ELECTRIC CO.

Shipped complete . . . ready for installation on a mobile power train . . . this 1,000 kw package type surface condenser is one of twenty-three designed and built by Lummus for the International General Electric Company.

Among the interesting features of design and construction are . . . tube sheets welded to the shell of the condenser, eliminating two packed joints (sources of possible air leakage) . . . complete deaeration of condensate in the hot well through the introduction of exhaust steam in the deaerating system . . . air ejector set, designed and built by Lummus is an integral part of the package unit.

Lummus designs and builds a complete line of surface condensers and other heat exchange equipment for stationary, marine, and refinery applications. Write for complete data.

LUMMUS *POWER PLANT* EQUIPMENT

- Surface Condensers
- Steam Jet Air Ejectors
- Bleeder Heaters
- Boiler Blowdown Heat Exchangers
- Evaporators
- Fuel Oil Heaters
- Lubricating Oil Coolers

THE LUMMUS COMPANY • 420 LEXINGTON AVE., NEW YORK 17, N. Y.

LUMMUS

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

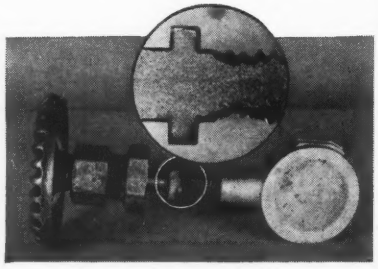
REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Strengthen Vulnerable Parts and Improve Your Product

The stem was the vulnerable part of this excellent and well designed valve. After two years service in an artesian well system, the stem was the only part of the valve which showed appreciable service deterioration. Dezincification caused threads to break off in many places. Analysis revealed the brass to be unsuitable to this type of use.

There are many good products which may be made better by making all parts from materials engineered to meet neces-



Enlarged cross-sectional view shows the dezincification of the metal with resulting failure of the threads on the screw. This deterioration would be avoided through the use of DURONZE III, thereby increasing the serviceability of the entire valve assembly.

sary service requirements. For example, valve stems, nuts, bolts and similar items made from Bridgeport's DURONZE III, a silicon aluminum bronze, combine high strength with exceptional resistance to severe corrosion. DURONZE III has the tensile strength of many carbon steels. It machines freely, hot forges readily and has a surprisingly low coefficient of

(continued from column 1)

friction when in contact with casting alloys commonly used in valve bodies and gates. DURONZE III resists season cracking, does not stretch or torque appreciably and may be generally depended upon to provide longer life and increased service.

Careful study of parts which fail in service often reveal improvement possibilities without necessitating design changes, by substituting modern alloys especially designed to combat excessive corrosion, fatigue, wear or deterioration. Bridgeport's 80-page DURONZE MANUAL, covering the technical details of DURONZE III and other Bridgeport silicon bronze alloys, is free for the asking. Every design engineer and plant superintendent should have a copy.

For Severe Corrosion Conditions —Cuzinal Condenser Tubing

Cuzinal (Aluminum Brass) Condenser Tubes were developed because of the steam turbine which depends upon a high vacuum for its maximum efficiency. To maintain a high vacuum it is necessary first to have a much greater flow of circulating water than required for reciprocating engines, and secondly the tubes must be kept as clean as possible.

The increase in water velocities through the tubes, which in the early days were either Admiralty or .70-30 Brass, led to a new type of corrosion, namely air impingement or erosion-corrosion. However, this high water velocity also has its advantages inasmuch as the rush of water expels sand, cinders, and other debris in addition to retarding the formation of slime. Under such conditions an alloy which is more resistant to air impingement than Admiralty is needed.

Bridgeport's Cuzinal which contains 76% copper, 2% aluminum and 22% zinc is far superior for handling high velocity sea water. To make it still better with respect to resisting deposits attack which may occur when silt and debris settle or attach themselves through the tube wall, Cuzinal contains a dezincification inhibitor in the form of arsenic. In addition, this alloy also is less scale forming, i.e., a thinner heat transfer retarding film will form on its surface than on some of the other alloys.

Bridgeport's staff of Metallurgists, Designers and Engineers will be glad to counsel with you upon your condenser tubing problems. If you have not already received it, why not send for your (free) copy of the Bridgeport Condenser Tube Manual, a comprehensive reference on all types of tubing used for condensers, heat exchangers, evaporators and general piping found in power plants, ships, oil refineries and process industries. Send for it . . . TODAY!

Note: Bridgeport products are supplied in accordance with existing priority regulations.

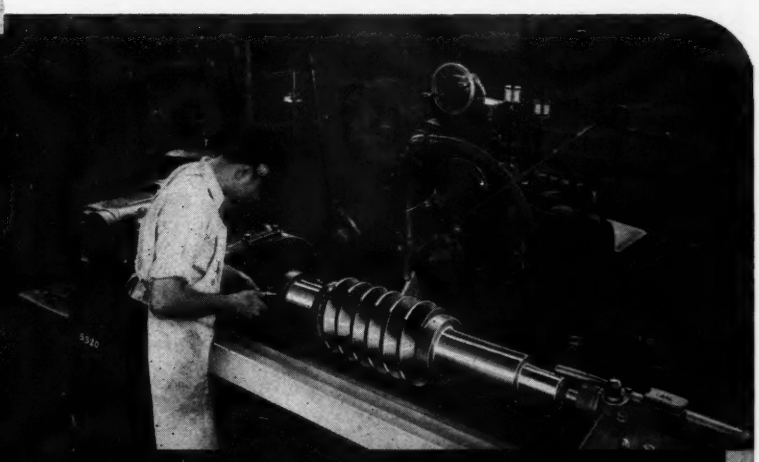
BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

ESTABLISHED 1865

Checking thread dimensions of worm in thread grinder to match those of a master worm.



Made to CLOSE LIMITS in Trenton

so that it will fit in Pittsburgh

Checking tooth contact at exact center distance with worm center across gear, measurements being taken with a 1/10,000 inch dial indicator.

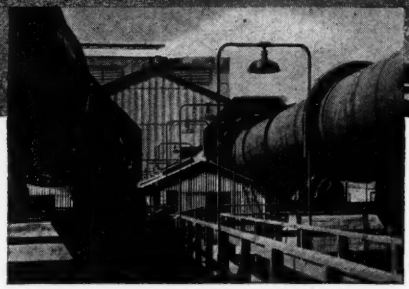
When you buy Worm Gear sets for building into your own machine tools, cranes, car loaders, conveyors, rolling mills, etc. you want to be sure that the parts are accurately machined to exact specifications and dimensions. Therefore specify DeLaval.

For the best results thread spacing on worms running at high pitch-line velocities must be accurate to within a few ten-thousandths of an inch. This degree of accuracy demands both precision production and precision checking.

M-28

De Laval Worm Gear Division of the De Laval Steam Turbine Co., Trenton 2, N. J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS. GEARS . . . WORM, HELICAL, and FLEXIBLE COUPLINGS



Austin Company—Architect, Engineer, Manager

K&M "Century" Asbestos-Corrugated and Flat Sheet Material is available now

Approximately 15,000 tons of K&M "Century" Asbestos-Corrugated Roofing and Siding have been used in the plants of this company . . . one of the largest magnesium producers in America. From these plants come much of the magnesium responsible for many of America's wartime achievements. This metal holds still greater promise for the peacetime years ahead. That's why the manufacturer chose K&M "Century" . . . noted for its permanence and low maintenance cost.

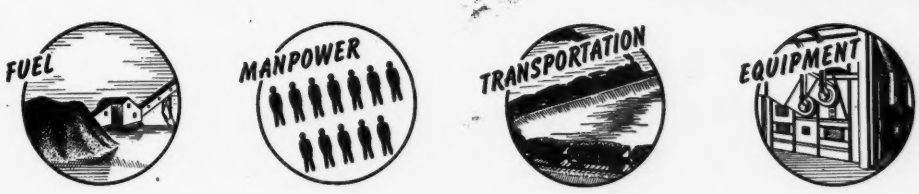
K&M "Century" Asbestos-Corrugated and Flat Structural Sheet Material offers *you* definite savings in building costs and maintenance costs. It is highly resistant to fire, corrosion and all kinds of weather. It combines the best qualities of two great building materials—asbestos and Portland cement.

K&M "Century" Corrugated Sheets in nineteen different sizes speed up construction, and its light gray color is pleasing and permanent. *It never needs paint for protection!* If your plans for plant expansion involve special problems, let Keasbey&Mattison, through its approved distributors, help you solve them with "Century" Asbestos-Corrugated and Flat Sheet Material.

Our Ambler plants proudly fly the Army-Navy "E" flag with its star—an honor awarded K&M employees "for continued outstanding production of war materials."

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

ENGINEERED INSTRUMENTATION CONSERVES



★ To be truly effective in the conservation of fuel, manpower, transportation, and major equipment, boiler room meters and control systems must be carefully engineered to the particular requirements of the plants which they serve.

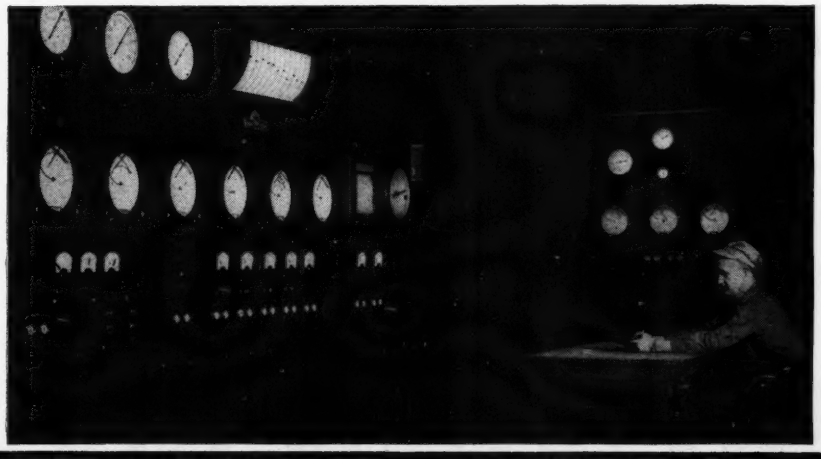
Thorough instrumentation engineering starts with a careful consideration of improvements which may be effected; and continues through with the application, design, construction, calibration, installation and adjustment of the meters and controls necessary to secure these desired improvements.

Bailey Meter Company, through its staff of thoroughly trained and experienced combustion engineers is helping power plant engineers to achieve their wartime conservation objectives.

Bailey Engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense. The Bailey Engineer in your community has a vast store of data at his command which includes results from tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that he has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation together with the other benefits which result from intelligent use of correctly selected and properly applied instrumentation.

G-22-1

BAILEY METER COMPANY • 1040 Ivanhoe Road • Cleveland 10, Ohio
Bailey Meter Company Limited, Montreal, Canada

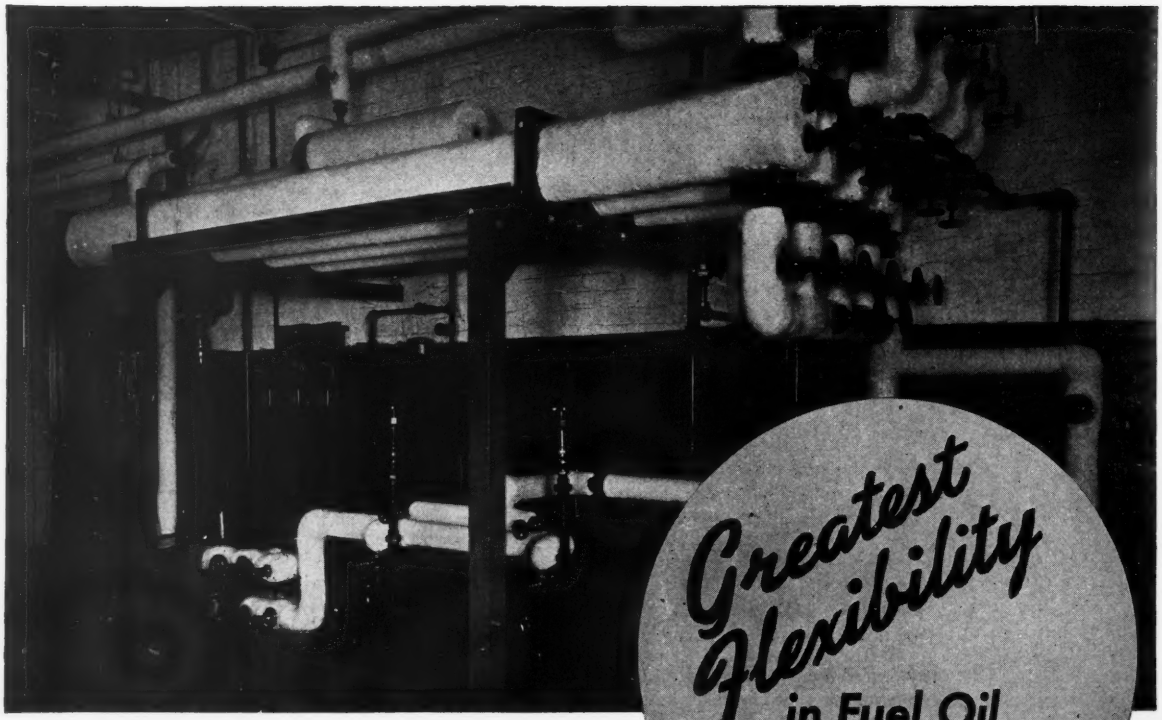


Bailey Boiler Control at the Wyandotte, Michigan Plant of Wyandotte Chemicals Corporation

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

The Complete Combustion Control System



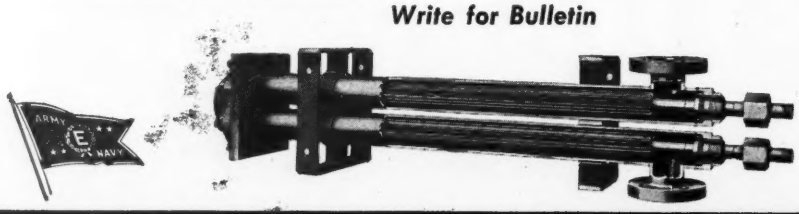
Greatest Flexibility in Fuel Oil Heating Installations

TWIN G-FIN SECTIONS...

These standard, interchangeable, compact heating units can be placed wherever convenient . . . connected in series or parallel for desired capacity and heating effect.

Individual units can be cut in and out of the line to maintain constant oil temperature at fractional loads . . . unused units can be inspected or cleaned without shutting down the entire heater installation . . . these are some of the reasons why TWIN G-FIN SECTIONS give GREATEST FLEXIBILITY in fuel-oil heating installations.

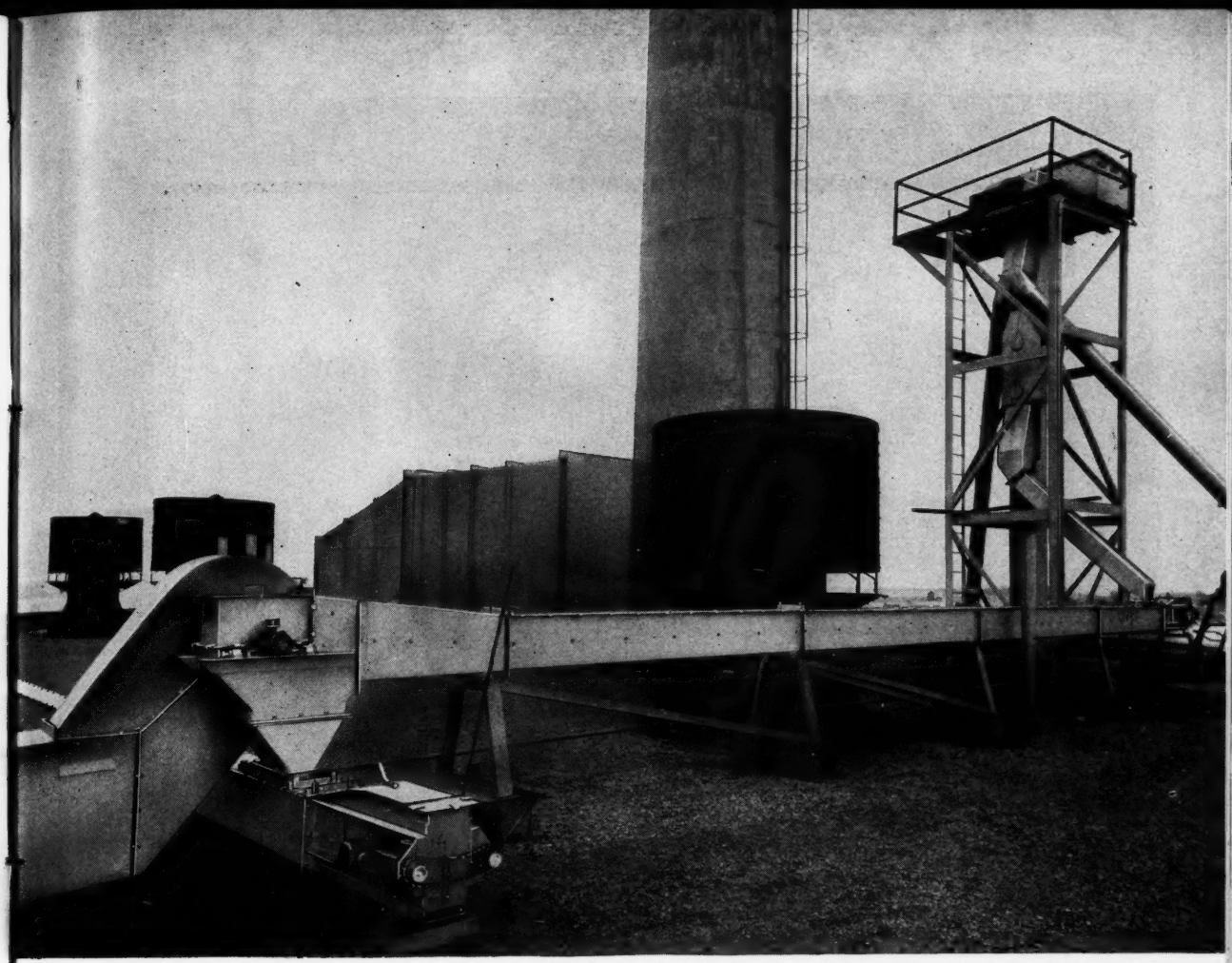
Write for Bulletin



The Griscom-Russell Co.
285 Madison Avenue
New York 17, N.Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



The unique coal handling system pictured above is located on the roof of a municipal power plant. Three compact Redlers, an elevator and two conveyors, store coal in silos, reclaim and distribute it to bunkers located beneath the roof. ALL REDLERS are completely weather-proof.

Unusual — BUT SOUND

S-A Equipment Plus S-A "Know-How" Are Equal to Any Handling Problem

● Each coal and ash handling installation presents its own problems. The very fact that the problems—and therefore the solutions—are different, explains why a great number of power plants depend on Stephens-Adamson for coal and ash handling equipment.

Stephens-Adamson manufactures a *complete* line of handling machinery, including conveyors, elevators, feeders, crushers and related accessories. In addition, S-A engineers are long experienced in assembling machinery units into speedy, efficient, low cost handling systems.

Take advantage of S-A's two-way service—engineering ability plus manufacturing facilities—when planning new or modernized coal and ash handling systems.

Write us for further information.

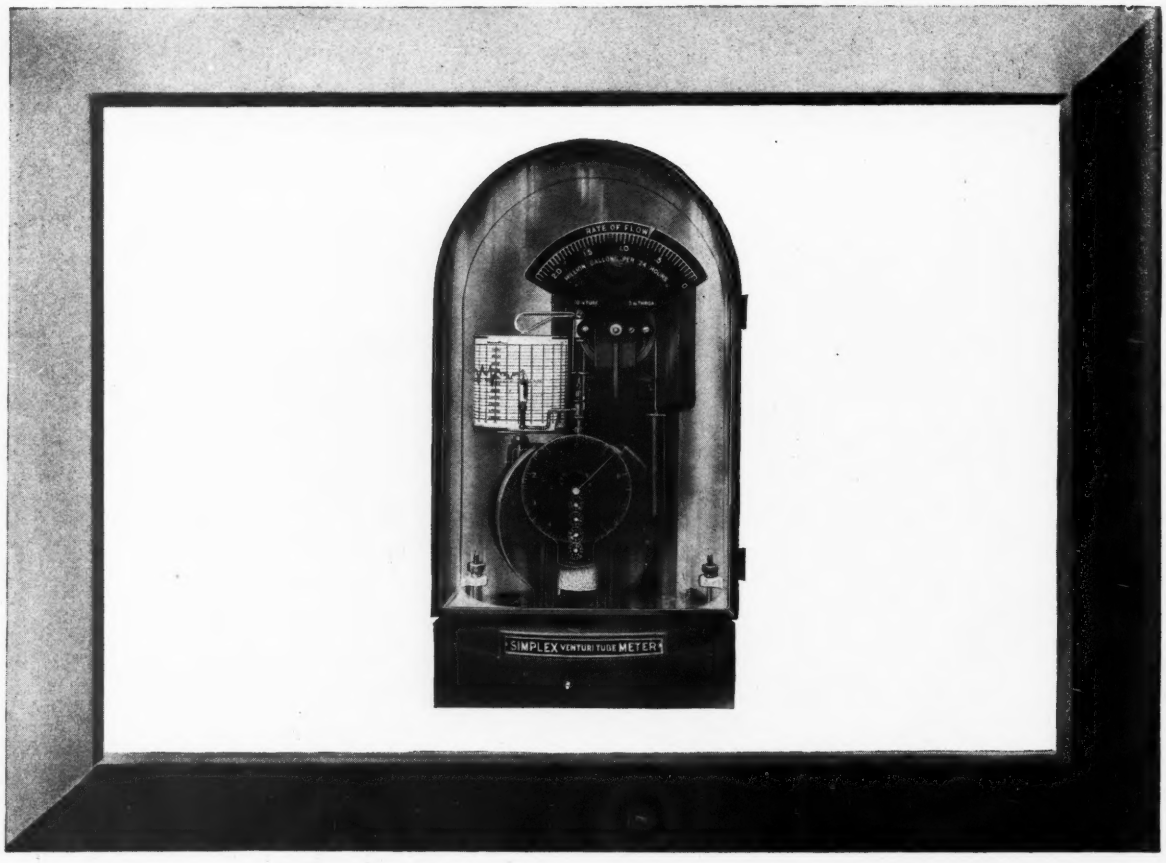
STEPHEN S-A ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS

LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



Portrait of "A MIND AT EASE"

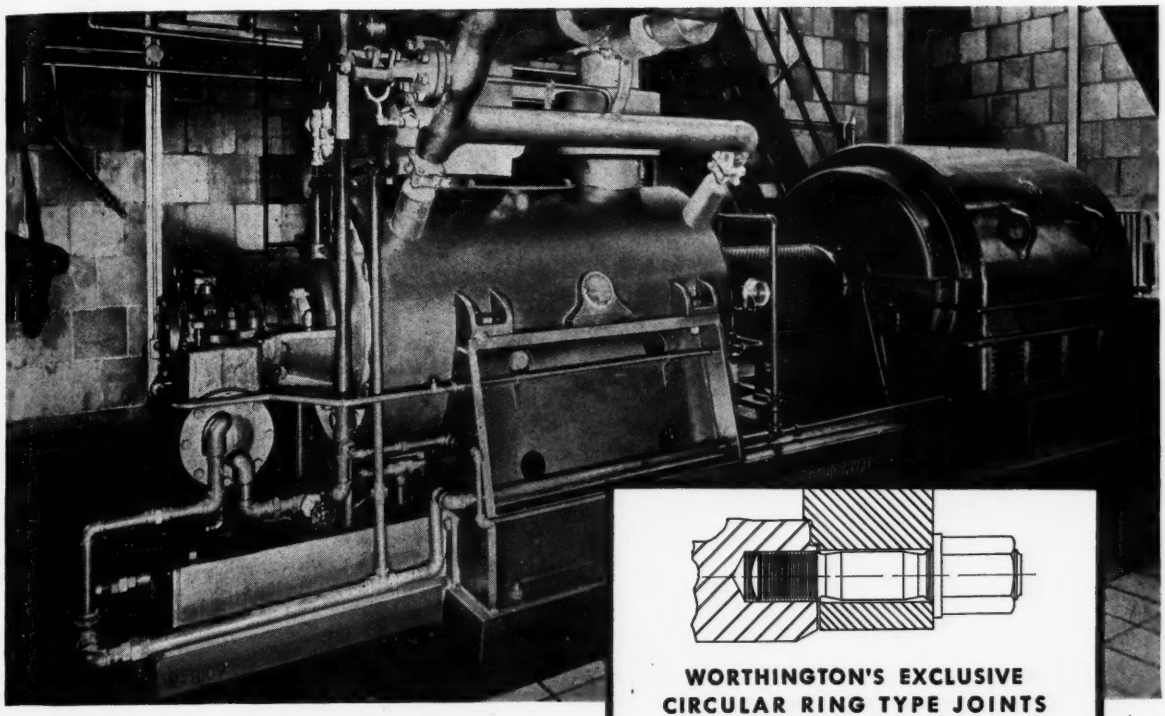
Simplex Type "MO" flow meters have established a reputation for long, dependable service that is taken for granted by thousands of operating men in power plants all over the country.

We receive many comments from new as well as old users telling us of the steady, behind-the-scenes job being done by this "master meter to check all other meters." The "MO" gives unequalled range of flow measurement; extreme sensitivity to the smallest measurable changes in differential head; and an over-all measuring efficiency which takes many a burden from the shoulders of already overworked operating staffs.

The Simplex "MO" meter indicates, records, and totalizes fluid flows with year-round, trouble-free accuracy. We will gladly send you complete information on the "MO" meter. . . . Simply address

SIMPLEX VALVE & METER COMPANY
6783 UPLAND STREET, PHILADELPHIA, PENNA.

30,000 HOURS . . . AND MORE!



WORTHINGTON'S EXCLUSIVE CIRCULAR RING TYPE JOINTS

Only Worthington's WC solid case boiler feed pump uses circular ring-type joints throughout, universally accepted as best construction for high pressure equipment. No gaskets needed.

Worthington High Pressure Boiler Feed Pumps make records for continuous operation in many plants

A typical station reports "32,627 continuous hours without major or minor overhaul"—an outstanding record, but not exceptional when you install a Worthington.

In 1923, Worthington supplied the first high pressure (above 1200 p.s.i.) boiler feed pump ever installed in the U. S. Since then, Worthington has consistently led the field in the number of installations in plants using steam at 1200 p.s.i. pressure or above.

Get the Right Pump for the Job

Worthington's WC high pressure boiler feed pump, shown here as installed in a leading power plant, is only one example of the application experience that will help you solve your specific boiler feeding problem.

"Know-How" from Unit Responsibility

It is natural that Worthington, with years of experience in engineering power plant equipment—from prime movers to valves and V-belts – should be able to place *more* "know-how" at your service. Write us. The Worthington Pump and Machinery Corp., Harrison, N. J.

WORTHINGTON *BEHIND THE NAME* WORTHINGTON

MEMBER

CP4-13

WORLD'S LARGEST MANUFACTURER OF PUMPS

STEAM POWER ROTARY TURBINE WELL CENTRIFUGAL

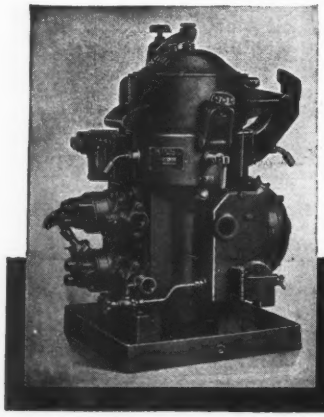
Purified Lubricating Oils are a NECESSITY TODAY

BECAUSE the primitive well-sweep was a simple, slow-moving device, its lubrication presented no problems. Engines and turbines of today, however, not only demand the very utmost of the oil refiner's skill but require further that the lubricants be kept continuously free from contaminating foreign matter. The most positive and economical way of keeping oil in "like new" condition is by means of the De Laval Centrifugal Oil Purifier.

De Laval Oil Purifiers instantaneously remove the impurities that contaminate lubricating oil in service—water, sludge, carbon and dirt. Oil from which these trouble makers are continuously removed will perform at full efficiency indefinitely.

De Laval Oil Purifiers are available either as separate units or in the "Uni-Matic" type which is complete with pumps and, if desired, with heaters. All sizes and models of De Laval machines make possible the same high degree of protection to bearings and moving parts.

Write for additional details.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 — 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL — PETERBOROUGH — WINNIPEG — VANCOUVER

DE LAVAL OIL PURIFIERS

Cooling Tower DOs and DON'Ts

-by MARLEY (No. 3 of a series)

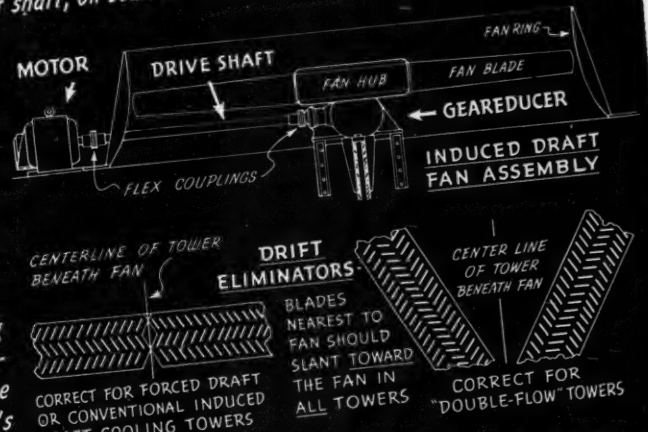
MECHANICAL MAINTENANCE

Well-kept equipment delivers the best operating results for the least overall maintenance cost.

FANS—Inspect frequently to see that blade clamps and hub bolts are tight. Fans may get out of balance, due to neglect and corrosion, and require rebalancing. Hence clean and paint all corrodible metal parts as often as necessary, depending upon the nature of the tower water and the atomosphere.

SPEED REDUCTION GEARS—Follow the manufacturer's lubrication instructions religiously. (Marley "Geareducers," although outstandingly rugged and trouble-free, nevertheless deserve and require the minimum care set forth on the name plate.) There is always slight "play" in ring and pinion gears, but if excessive, wear is indicated. Pinion shaft end play or fan shaft side play indicates excessive bearing wear. If oil leaks around either shaft, oil seals should be replaced.

DRIVE SHAFTS—Keep drive shafts in alignment and balance, all coupling bolts tight. Replace or repair universal joints or flexible couplings when worn. Lubricate these joints as necessary. (Marley's disc-type couplings require no lubrication.) Keep shaft guards securely in place.



MOTORS—Grease ball-bearing motors with an approved water-resistant lubricant every one to three months, according to manufacturer's instructions. Do not over grease.

Once a year check insulation value with a megger, or by similar means, and paint the motor winding with approved insulation varnish and the frame with anti-rust paint.

WOOD PARTS AND FRAMEWORK—Check drift eliminators each season to see that all blades are in place and alignment. If necessary to remove any section, make sure it is replaced with blade edges slanting toward the fan as illustrated in the accompanying sketch.

Well-designed filling (the "decking" or latticework inside most larger towers) will not sag or warp appreciably but if such condition is noted, correct it. Replace broken laths.

Bolts of tower frame and casing should be tightened yearly and corrodible metal parts painted. Redwood does not require painting for weather protection.

MARLEY COOLING TOWERS

34-A

DO YOU KNOW — that the Marley Geareducer is the only speed reducer designed specifically for cooling tower service and the only such drive furnished as standard equipment. Rugged dependability under the most severe conditions. Positive, direct drive for fans from motor outside of fan ring in an accessible location out of the hot, damp air stream.

THE MARLEY COMPANY, INC. · KANSAS CITY · KANSAS

BROWN
HIGH RANGE METER RECORDS & INTEGRATES FROM 25-100% OF CAPACITY
LOW RANGE METER RECORDS & INTEGRATES FROM 0-25% OF CAPACITY
3 CONDUCTOR CABLE
3 CONDUCTOR CABLE
HIGH RANGE METER BODY
LOW RANGE METER BODY
WIDE RANGE STEAM FLOW METER INSTALLATION

Ideal for WIDE RANGE FLOW

Operating Advantages

1. **Operates on the Inductance Bridge Principle! Inherently independent of voltage changes.**
2. **AUTOMATIC PLANIMETER PEN gives you a record on total flows over any period of time.**
3. **SIX INTERCHANGEABLE RANGE TUBES assure quick adjustment to changes in operating conditions.**
4. **INTEGRATOR DIAL. Easy to read. Simple counter — plain figures. Read it like your automobile mileage indicator.**

FOR metering steam where the flow varies over extremely wide ranges, the Brown Flow Meter System shown above, fulfills every requirement for high pressure steam heating and process loads.

The system consists of two meters connected to the same orifice. The low range meter records and integrates the flow from 0 to 25 per cent of maximum.

The high range meter records and integrates flows from 25 per cent to 100 per cent of maximums. The sum of both integrator readings gives the total steam flow. The change from one meter to the other is automatic and requires no manual operation.

Either or both meters can be supplied with auxiliary indicating scales and can be equipped with air control features in case it is desired to limit the maximum flow.

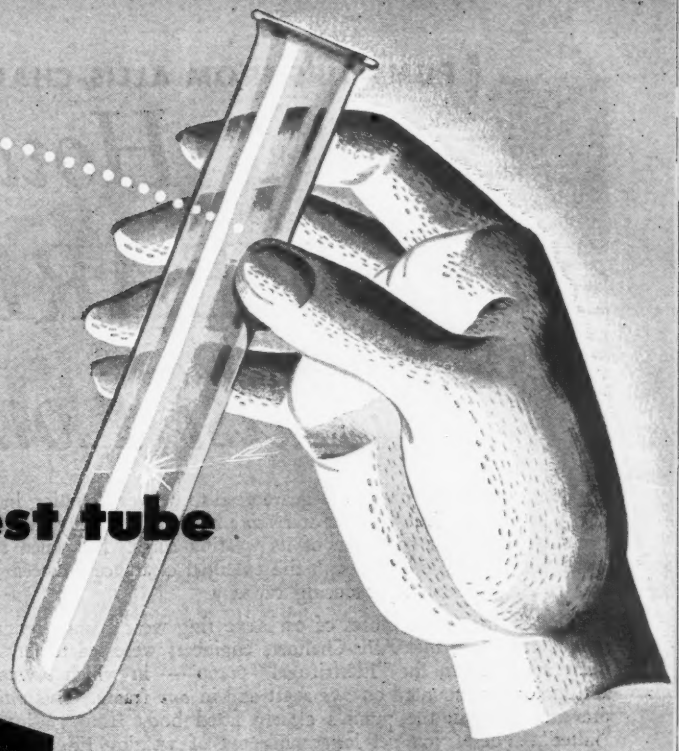
Brown Flow Meters are a guarantee of satisfaction to both the user and producer—for example, in the City of Washington, D. C., there are more than thirty stations where steam is measured by this practical method.

The Brown Wide Range Meter System is easily installed in large and small central distribution plants where accurate accounting is a requisite.

Write for Catalog. THE BROWN INSTRUMENT COMPANY. **a division of Minneapolis-Honeywell Regulator Co.,** 4491 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—England: Wadsworth Road, Perival, Middlesex—Stockholm, Sweden: Nybrokajen 7.

BROWN FLOW METERS
. . . MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS . . .
To Measure and Control is to Economize

scale-free boiler tubes start in a test tube



SCIENTIFIC analysis of your water supply by the Dearborn laboratory and a thorough study of your operating conditions by Dearborn engineers is the beginning of the Dearborn treatment method.

Analyze all conditions first then treat the water with special Dearborn reagents. Control the feed by systematic check-up and your boilers will be maintained in full steaming condition to carry the extra loads demanded these days. Over 8000 plants using this service will certify boilers *remain* scale-free. Protection against pitting and corrosion is accomplished by this treatment.

The Dearborn engineer in your vicinity knows local water characteristics. He'll be glad to help you solve your boiler water problems.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave., Chicago 4, Ill.

Dearborn Engineer does this for you . . .

1 Studies your water and plant operating conditions.
2 Sends samples of your water to main laboratory for analysis.
3 Recommends proper chemical treatment and chemical control methods.
4 Supervises installation of feeding equipment.
5 Instructs your men on water test methods for treatment dosage adjustment and blow-down control.
6 Calls regularly to insure maintenance of recommended conditions.

Dearborn
TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make WEARING RINGS Last Longer . . .

ANY NEW PUMP you buy is guaranteed to deliver its rating in capacity and head. But whether it *retains* its actual capacity depends to a great extent on the condition of its wearing rings. For when rings are worn thin, liquid leaks through the enlarged clearance between impeller and casing — seriously reducing capacity.

One of the major causes of excessive ring wear is misalignment. So serious can it be, that Allis-Chalmers engineers were led to develop, for many applications, the "Electrifugal" pump — in which *both* impeller and motor are mounted on *one* shaft and in *one* frame. This *unit-design* prevents parts in the pump's closely fitted body from getting out of "kilter" . . . helps you get longer life out of wearing rings.

However, regardless of whether you have a unit-design or separately coupled pump and motor, here are a few tips which will help you get longer wear from rings in your pumps . . .

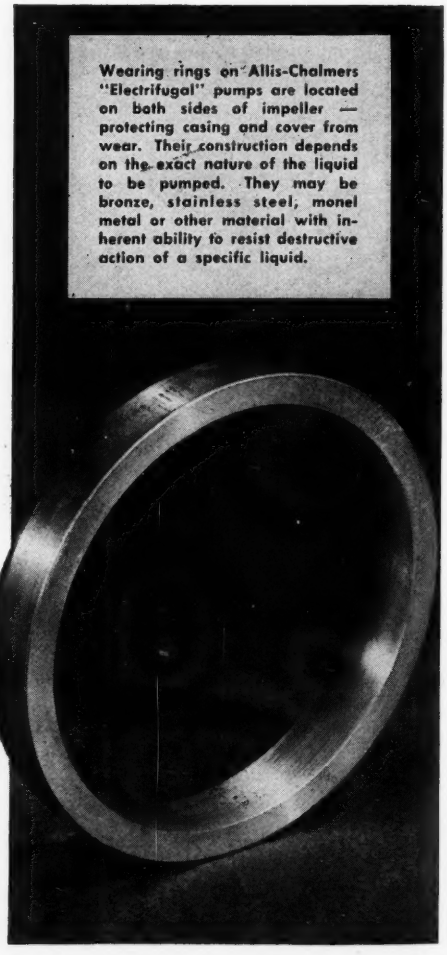
▸Never allow a pump to run dry — either through lack of proper priming when starting, or through loss of suction when operating. Remember . . . water is a *lubricant* between rings and casing.

▸Examine wearing rings at regular intervals. When new, rings in the smaller size, more commonly used pumps should have a diametrical clearance of about 0.006 to 0.008 inch on cold liquid service, and about 0.010 to 0.012 on hot liquid service. When ring clearance becomes 0.020 to 0.030 inch on the diameter it is more economical to replace rings than to pay for power lost in leakage through them.

▸Gritty liquid or foreign matter in liquid accelerates ring wear. If condition exists, provide intake end of suction piping with a suitable screen to filter out abrasive materials.

▸Watch pump alignment. Excessive strains from suction or discharge piping can and do distort casing. Wearing rings protect pump from serious damage in this event by themselves taking the wear. However, *before* installing new rings, be sure to check into the *source* of distortion.

▸Send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". This valuable booklet applies to *all* makes of pumps; contains *no* advertising. Contents include: tables of friction losses; guide to locating trouble; wartime maintenance schedule. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN. A 1756

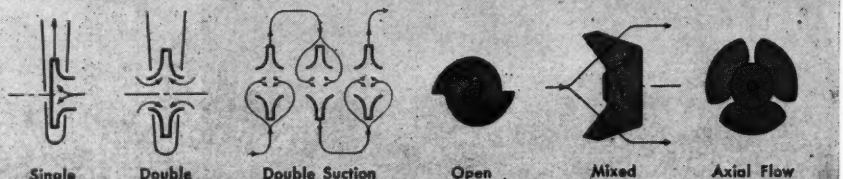


Wearing rings on Allis-Chalmers "Electrifugal" pumps are located on both sides of impeller — protecting casing and cover from wear. Their construction depends on the exact nature of the liquid to be pumped. They may be bronze, stainless steel, monel metal or other material with inherent ability to resist destructive action of a specific liquid.

♪ *Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.*

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



TODD SHOWS YOU HOW . . .

IT'S your wartime duty to conserve fuel. You can combine duty with smart business by modernizing your boiler room with TODD combustion equipment.

TODD oil or gas burners cut fuel consumption and maintenance charges, yet increase the production of power and heat. *TODD burners reduce the cost of a pound of steam!*

Think what this will mean after the War when your competitors put emphasis on price.

Already, many factories, commercial buildings and power houses are enjoying low-cost steam production with TODD oil or gas burners. Fuel savings as high as ten percent—and even larger increases in heat and power production—are being reported regularly.

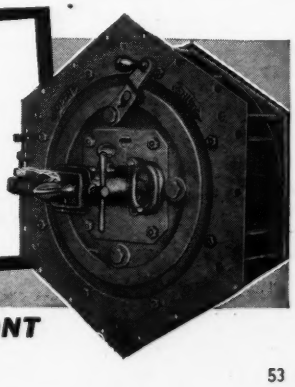
Now is the time to survey your boiler plant . . . while fuel conservation is a wartime "must" . . . while power production is at a premium . . . while your postwar plans are being developed. TODD engineers will be glad to make an impartial study of your entire heat and power setup — without obligation.

Act now to help your government conserve fuel . . . and help yourself to lower operating expenses by reducing the cost of a pound of steam!

ARMY E NAVY

TODD SHIPYARDS CORPORATION
(COMBUSTION EQUIPMENT DIVISION)
601 West 26th Street, New York 1, N. Y.

NEW YORK ★ BROOKLYN ★ HOBOKEN ★ BARBER, N. J. ★ SO. PORTLAND, ME.
GALVESTON ★ HOUSTON ★ MOBILE ★ NEW ORLEANS ★ LOS ANGELES
SAN FRANCISCO ★ SEATTLE ★ TACOMA ★ BUENOS AIRES ★ LONDON



ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

BACKING THE

BUY MORE WAR BONDS!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **BABCOCK**

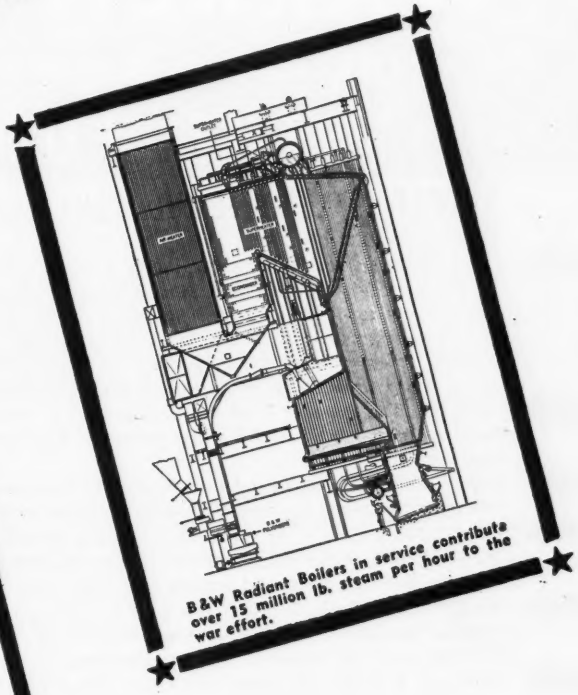
ATTACK...with POWER

What's back of the smashing offensive that is carrying the war to the Axis? The dynamic energy of management and labor . . . the amazing ingenuity of engineers . . . and, not least, the gigantic load shouldered by our public utilities and industrial power plants.

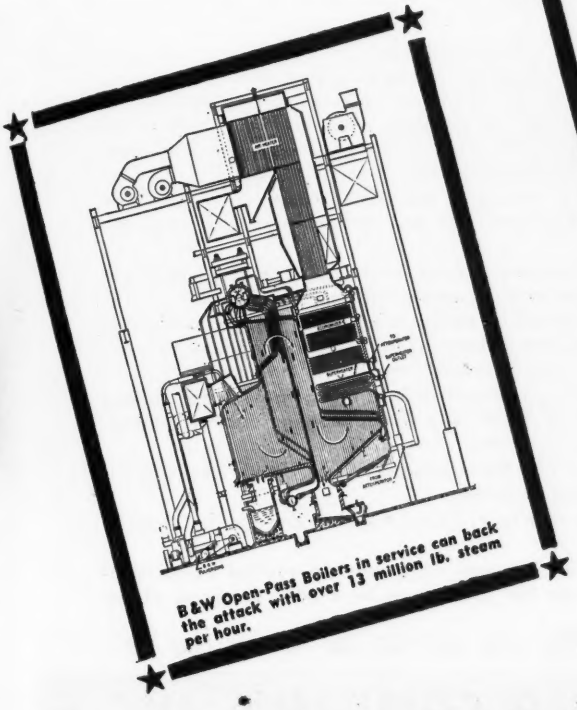
It would be impossible to over-emphasize the importance of power to the almost incredible production of ships, planes, tanks, guns, ammunition, and other war material. In producing steam to supply electrical energy, American power plants are keeping war-plant machines humming at stepped-up speeds never before attained. As J. A. Krug of WPB aptly sums it up, "Power has never been too little or too late."

Working with power plant executives and personnel has been a privilege for Babcock & Wilcox . . . and an opportunity to apply our experience in steam generation to the war-vital needs of expanding and maintaining boiler capacity.

We at B&W know that when the history of this war is written, the electric light and power industries will receive high recognition for a job well done . . . even wider recognition than the special citation already conferred upon them "for distinguished wartime achievement."



B&W Radiant Boilers in service contribute over 15 million lb. steam per hour to the war effort.



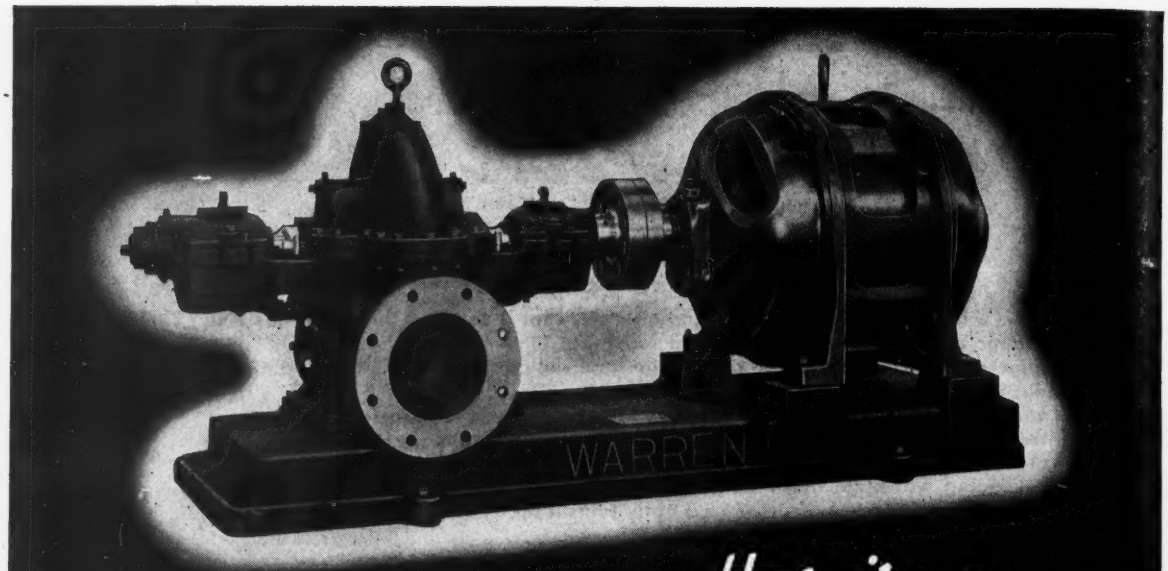
B&W Open-Pass Boilers in service can back the attack with over 13 million lb. steam per hour.

The Babcock & Wilcox Company

85 Liberty Street, New York 6, N. Y.

& WILCOX ★★★★★★★★★★

G-274T



Here's a

WARREN PUMP

TO THINK ABOUT WHEN YOU THINK ABOUT

THE FUTURE

SINGLE STAGE • DOUBLE SUCTION • TYPES DM and DL

Check these features:

CASING: Pump casing is of the double suction, volute type divided on the horizontal center-line. Suction and discharge nozzles are cast integral with lower half. Bearing brackets on smaller sizes are cast integral with lower half of pump casing. On larger sizes brackets are securely bolted and dowelled to the pump casing. Water passages are designed to produce smooth flow with gradual changes in velocity. By removing case cover and bearing caps, the entire rotating member may be removed for inspection or repair without disturbing pipe connections.

IMPELLER: The impeller is of the enclosed type, accurately machined and balanced to insure freedom from vibration. All water passages are hand filed and renewable impeller rings are standard equipment.

SHAFT: Shafts are machined and finished by grinding to accurate dimensions and are of ample diameter to safely transmit the required power without undue bending or twisting.

CASE RINGS: Case rings are securely held in place by means of a tongue and groove lock in the lower half of the pump casing. This construction maintains parallel clearance spaces between impeller and case rings and secures case rings against rotation and lateral movement.

BEARINGS, RADIAL: Bearings are of the split type, ring oiled, lined with genuine babbitt, bolted together and held in place by the bearing cap which also locks bearings against rotation. Bearings may be replaced without disturbing the rotor.

BEARING THRUST: All pumps are fitted with a ball thrust bearing of the double row angular contact type, designed to take thrust in either direction.

PACKING GLANDS: Packing glands are of the split type, bolted together and can be removed without disturbing other parts.

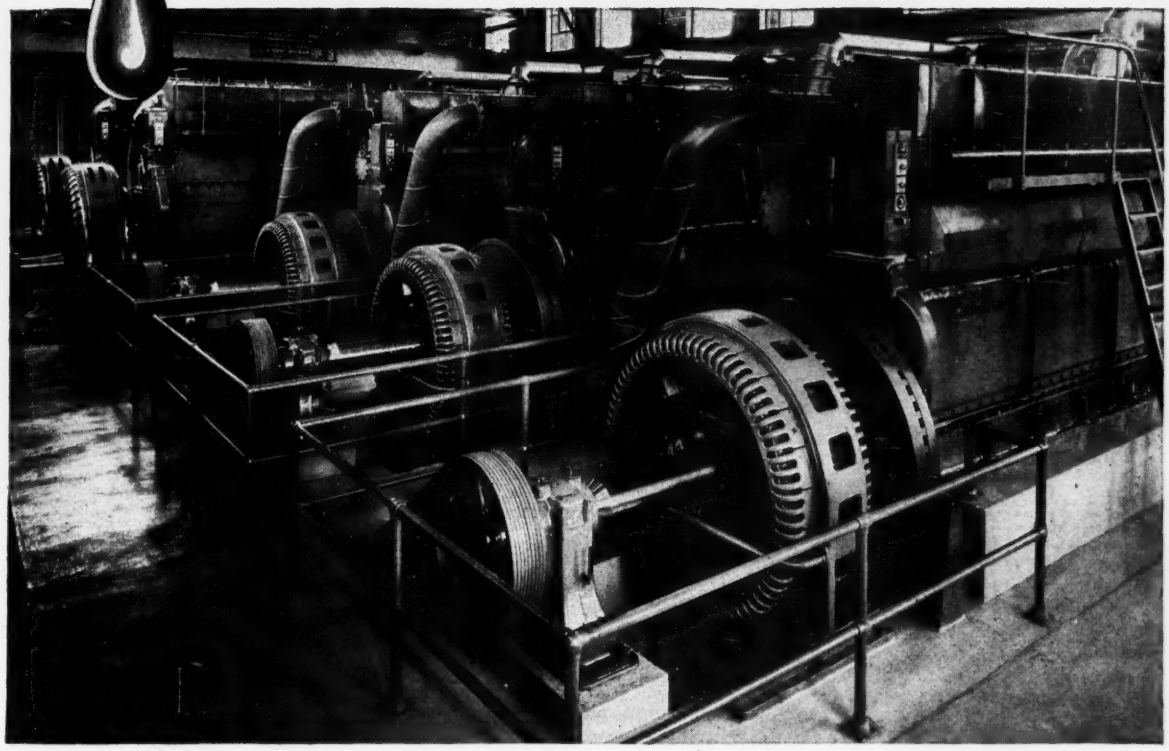
TESTING: Every Warren pump is given a running test and all guarantees verified before shipment. Each casing is subjected to a hydrostatic test pressure at least 50% in excess of the operating pressure.

FOR COMPLETE SPECIFICATIONS AND RATINGS ASK FOR BULLETIN 227-1

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

CORRECT Lubrication means *Better Maintenance*



PROBLEM—excessive wear, difficult maintenance.

SOLUTION — *Correct* lubrication.

For *correct* lubrication of Diesels, Sinclair provides both RUBILENE and GASCON OILS to meet the different requirements of various types of engines.

These oils are non-gumming and highly sludge-resistant. They seal compression, reduce ring wear, and give *safe* lubrication under continuous heavy loads.

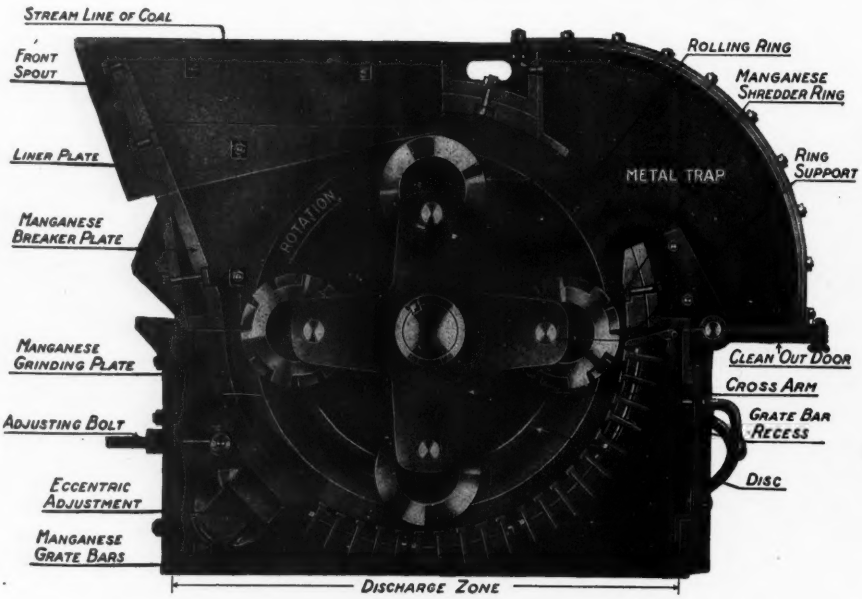
Is maintenance a worry? Let us tell you how Sinclair lubricants make for *better maintenance*.

(Write for "The Service Factor"—published periodically and devoted to the solution of lubricating problems.)

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

A "LOOK-IN" on equipment that permits the use of difficult-to-grind coals . . . .



COAL IS GOING TO BE YOUR PROBLEM

Most of the problems which lie ahead for power engineers will center around coal—how to prepare coals having low grindability index—how to burn coals to produce steam at lowest overall cost—what equipment to use for preparing the kind of coal that will be available. Because coal holds the center of the stage and must be properly sized for economical use with stokers or for pulverized fuel firing, let's look into the "AMERICAN" way which has already been proved in service.

THE AMERICAN RING CRUSHER

Varies Sizing To Meet Requirements

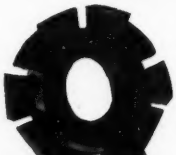
Reference to the cross section of the AMERICAN RING CRUSHER shown here reveals its simplicity of design. The "AMERICAN" is different from other centrifugal types in that its housing is a heavy cast steel casting, reinforced with ribs, a construction making it practically unbreakable. Then, too, anti-friction bearings, mounted dust-proof and oil-tight, reduce power requirements. Rotor shaft is of alloy steel, with spiders and cross arms keyed; rings are supported on shafts of high carbon steel and staggered to cover the entire grinding surface.

Crushing parts, including breaker plate, grinding plate, grate bars and rings are of manganese steel. Grinding plate is adjustable while crusher is in operation, making it possible to vary sizing to meet specific requirements. Housing is lined with manganese steel liners, easily replaceable for wear. A metal trap or tramp iron catcher can be provided for protection against non-crushable material.

AMERICAN RING CRUSHERS are built in sizes to handle from 25 to 500 tons per hour. Write for bulletin covering complete details.

Note These Features:

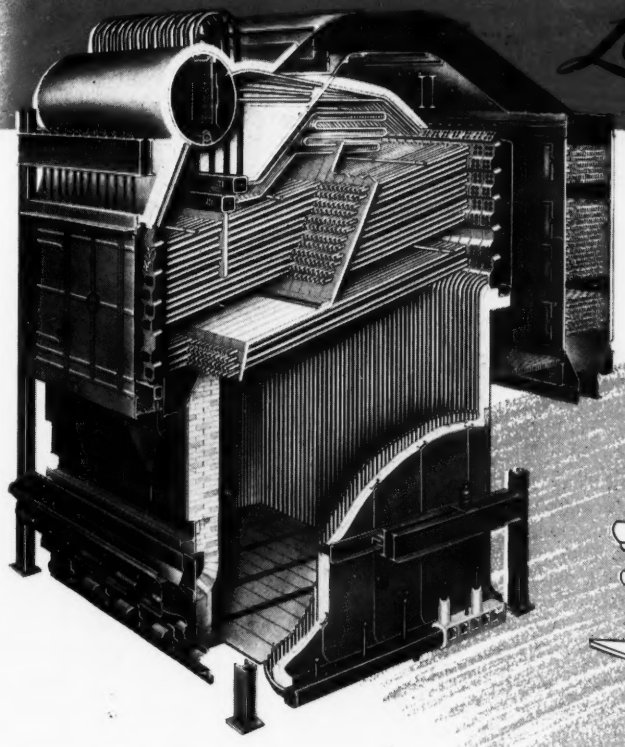
One of the Manganese Rolling Rings, in AMERICAN CRUSHERS, weighing about 27 lbs. Each of these rings applies centrifugal force at right angles to horizontal shaft. The ring strikes, rolls and crushes.



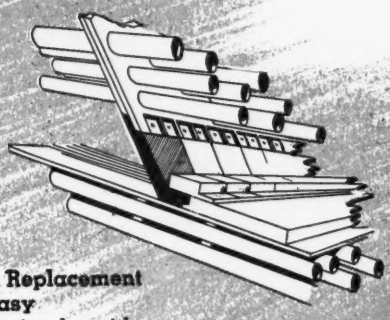
Patented manganese shredder rings in AMERICAN CRUSHERS split the coal and prevent clogging. Each ring has twenty cutting edges and maintains its outward position by centrifugal force. Because these rings are free to swing out of position, they are readily deflected when coming in contact with tramp iron. No safety devices are therefore necessary to assure protection.

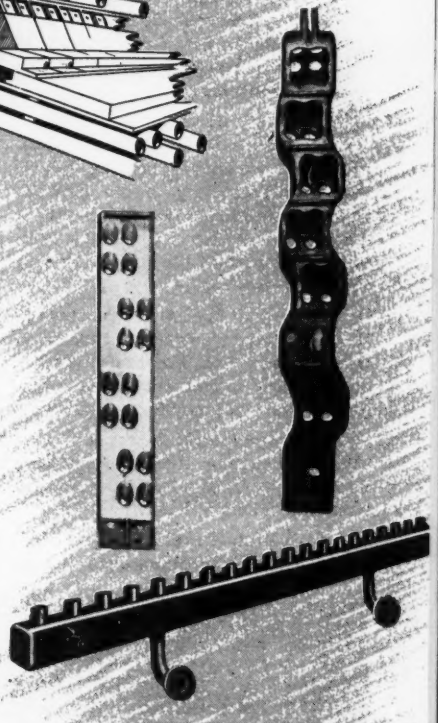
AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis 10, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

Springfield features that insure *Longer* BOILER *Life*



OUT of Springfield's 55 years of experience in designing and building various types of boilers have come many improvements which prolong boiler life and maintain efficiency.





Corrosion-Free Mud Drum

Nowhere in the boiler is the corrosion-free quality of cast electric steel so important in reducing maintenance as in the mud drum. No mud drum on a Springfield boiler has had to be replaced since Springfield changed from wrought steel to cast steel mud drums more than 10 years ago!

Cast Electric Steel Headers

Casting plus full annealing provides a steel header which is free from seams or crevices to start corrosion or embrittlement. Casting provides a material which has both high tensile strength and ductility without being "soft"—the best combination to insure stronger, permanent, rolled connections.

Permanently Tight Baffles

Sectional baffles of rugged construction designed to take full advantage of the cooling effect of the boiler tubes are another Springfield feature insuring lower maintenance and longer life. Joints between baffle sections are reduced to a minimum and are all offset sealed.

Where the baffle wall is exposed to high temperature, such as the junction between horizontal baffle and first pass baffle in the above illustration, easily renewable sections are provided.

20 years and more of service without maintenance is a common occurence with Springfield baffles.

Tube Cleaning or Replacement Made Easy

Tube cleaning is simple with a Springfield boiler and any tube may be replaced without disturbing the baffles or any other parts of the boiler. This maintenance operation is made easy by two Springfield details. Holes in the baffle wall are metal lined and are belled to make tube replacement easy. Four-tube handhole openings provide maximum accessibility. Easier maintenance insures better maintenance and longer life.

Shop Assembly and Testing

Using the best factory tools and equipment, skilled specialists at the factory assemble sections more accurately and test them more carefully than can be done in the field. Springfield water walls as well as boilers are shop assembled in sections when possible.

Other Springfield Features

Springfield design as well as construction incorporates the best features of modern boiler practice. Small diameter tubes, staggered to insure gas contact, scientifically baffled cross drum, "tailored" water walls, superheaters, and economizers all combine to provide a modern, quick-steaming boiler, easy to operate, easy to maintain, low in operating cost, high in operating efficiency. Send for the complete Springfield story. Write today.

SPRINGFIELD BOILER COMPANY
1951 E. Capitol Ave., Springfield, Ill.

SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE
ANY FUEL
ANY PRESSURE

HEAT TRANSFER

. . . and a few often-neglected factors that affect it

The *thermal conductivity* of a metal is one thing.

The actual *heat transfer* from one fluid to another through the metal may be a different story altogether.

For thermal conductivity is listed on an *ideal* working basis. It does not take into account the practical factors that may slow down heat transfer under working conditions.

It does not allow, for instance, for corrosion deposits and films that form on metallic walls or for heating or cooling gases that cling to the metallic walls. These films have such low conductivity that they often make relatively unimportant the conductivity of the metal itself.

The diagram (below) illustrates the slow-up in heat transfer from corrosion products and film. The table lists the conductance ranges for metal walls, and for films that may form upon them.

These comparative figures show why other factors than rated thermal conductivity are of greater importance in heat transfer equipment.

All the INCO Nickel Alloys are highly resistant to corrosion, even at high temperatures. They develop very thin and tenacious oxides within their limiting temperature range. They do not scale or build up heavy insulating jackets of corrosion deposits. Their clean smooth surfaces keep down accumulations of sludge and deposits which might retard heat transfer.

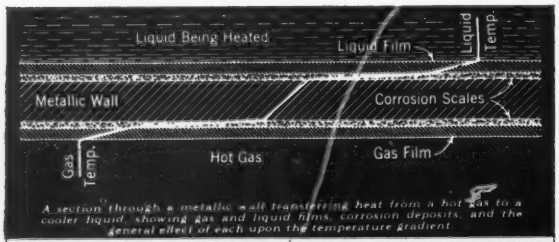
These are the reasons for the remarkably rapid heat transfer rates which nickel and the INCO Nickel Alloys provide under actual service, especially where corrosive conditions and high temperatures are encountered.

* * *

A practical example which illustrates the usefulness of INCO Nickel Alloys for heat transfer work is the performance of Monel tubing used in three of the latest high-pressure power stations:

TWIN BRANCH PLANT, of the Indiana and Michigan Electric Company, a subsidiary of the American Gas and Electric Service Corporation. The plant was designed to generate steam at a new high pressure for commercial units . . . 2500 lbs. Steam bled from the turbines at temperatures as high as 637° F., and pressures as high as 700 psi, surrounds the Monel tubing through which 550,000 pounds of water an hour rush under pressure of 3200 psi. Despite the speed at which it moves, the water is boosted from 353° F., to 490° F., due to the excellent heat transfer properties of the Monel tubing.

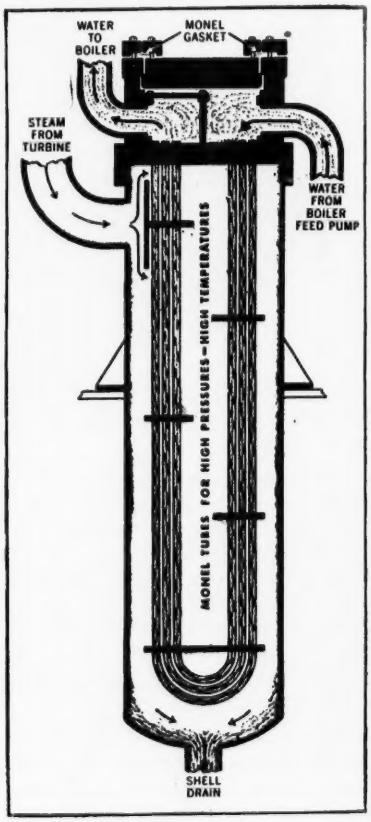
NARRAGANSETT ELECTRIC CO., Providence, R.I. Steam is bled from the turbine at 700° F. 430,000 pounds of water, under pressure of 1300 psi, pass through the Monel tubing every hour. The water is pre-heated to 400° F., before entering the high-pressure boiler.



A section through a metallic wall transferring heat from a hot gas to a cooler liquid, showing gas and liquid films, corrosion deposits, and the general effect of each upon the temperature gradient.

Comparison of the Conductance Ranges for Metallic Walls and Films

Nature of Obstruction	Conductance Range Btu. hr. sq. ft. F
Metal wall	
1 in. thick	75 to 3,000
0.025 in. thick	3,000 to 120,000
Condensing vapor	1,000 to 8,000
Evaporating liquid	500 to 2,000
Liquid being heated	50 to 500
Liquid being cooled	40 to 400
Gas being heated	5 to 50
Gas being cooled	5 to 40
Corrosion scale	5 to 20



Cross-section of typical heat exchanger of the type used in Narragansett Electric Co. Plant. Note use of Monel Tubing.

OSWEGO PLANT of the Central New York Power Corp. Steam is bled from the turbine at 770° F., at a pressure of 600 psi. Internal water pressure in the Monel tubing is 2000 psi. The swiftly rushing water is pre-heated to 450° to 485° F.

Recently, all three installations were inspected. In addition to performing their heat transfer job, the Monel tubes in these heaters have stood up perfectly under the high pressures, high temperatures, and corrosive, erosive attack to which they have been subjected.

For further information about heat transfer, write for the INCO Technical Bulletin: "Heat Transfer through Metallic Walls." Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET NEW YORK 5, N. Y.

We can all be Proud of that Improvement

"It was just about 15 years ago, Jim, that the first plans came off the Busch-Sulzer designing boards for trunk pistons in big Diesels. Even you fellows here in the shop were skeptical, remember?"

"We sure were Boss—and so was the industry when we built the biggest trunk-piston Diesel on Earth."

"But these big fellows have proved themselves year in and year out, Jim. We can honestly say that we have built Diesels that built Busch-Sulzer's reputation."

Busch-Sulzer Diesels are simple, dependable and long-lasting. In improving its product constantly for over 45 years, America's oldest builder of Diesel engines has striven always for simplicity of design. As a result, a Busch-Sulzer Diesel offers maximum continuity of operation with a corresponding minimum of time lost on inspection and maintenance.

Busch-Sulzer offers single-acting two-cycle engines up to 8000 BHP in one unit. Busch-Sulzer also has a complete line of four-cycle engines in sizes 225 BHP to 1500 BHP, in super-charged and unsuper-charged types, suitable for marine or stationary use. A request on your letterhead will bring particulars.

BUSCH-SULZER
ST. LOUIS

BUSCH-SULZER BROS.–DIESEL ENGINE COMPANY • SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

TO TURN ON THE HEAT • TURN TO PEABODY . . .

DIRECT FIRED AIR HEATER
OIL PUMP AND HEATER SET
MARINE OIL BURNER
REFINERY BURNER FOR GAS AND OIL
COMBINED COAL AND OIL BURNER
COMBINED GAS AND OIL BURNER
GAS AND AIR SCRUBBERS, COOLERS, ABSORBERS
BLAST FURNACE GAS BURNER

BURNERS — Peabody builds burners for natural and forced draft — for rich and lean gases, oil and pulverized coal, fired singly or in any combination.

HEATERS — Peabody high pressure, high temperature air heaters — direct fired, burning oil or gas, or both — have many uses in catalytic plants, in gas turbine operation, etc.

GAS AND AIR SCRUBBERS, COOLERS OR ABSORBERS — Peabody Scrubbers remove unwanted substances, such as dust, ash, fume and bacteria from gas and air.

BLAST FURNACE GAS BURNERS — The Peabody Blast Furnace Gas Burner is a large capacity unit of high efficiency. It can be supplied for firing in combination with other fuels.

OIL PUMP AND HEATER SETS — Peabody builds them for power plants, ships and industrial installations.

Peabody equipment is the product of years of concentration and specialization in the field of combustion engineering. Specify it for your plant and let Peabody engineers assist in working out your requirements.

To turn on the heat, turn to Peabody

PEABODY ENGINEERING CORPORATION

580 FIFTH AVENUE • NEW YORK

ATLANTA · BOSTON · CHICAGO · CLEVELAND · DENVER · DETROIT · EAGLE PASS (Tex.) · HONOLULU · HOUSTON · KANSAS CITY · LOS ANGELES · NEW ORLEANS · PHILADELPHIA · PORTLAND (Ore.) · ST. LOUIS · ST. PAUL · SAN FRANCISCO · SEATTLE

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PEABODY LIMITED, LONDON

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn No. 4

Corrosion of Condenser Tubes ...Causes and Cures

Scovill offers two folders on obtaining longer tube life

Among the common causes of corrosion in condenser and heat exchanger tube metal are the following, each of which is discussed in two folders which have been prepared by Scovill Manufacturing Company engineers as one of three Scovill services to power plant operators:

Film Formation

The ability of copper and its alloys to form protective films on their surfaces explains their inherently excellent corrosion resistant properties. In order to be protective, the film must be adherent, continuous and relatively insoluble. The formation of soluble salts at the metal surface will lead to continued corrosion. Likewise, coatings which are porous, loosely adherent, friable or easily broken, or discontinuous, offer little protection to the metal.

Accelerated Uniform Corrosion

Tubes in service under conditions which result in corrosion at the tube surface with the formation of soluble salts only, will undergo a uniform thinning of the tube wall. This is often experienced in acid solutions, particularly with oxidizing acids or acid solutions containing oxygen or an oxidizing agent. Solutions which have a definite solvent action on the products of corrosion of copper alloys, such as solutions containing ammonium hydroxide or cyanides, would behave similarly.

Impingement Attack, End Corrosion, etc.

Rapid and repeated destruction of protective surface films usually occurs at or near the inlet end of the tubes and is variously described as "impingement attack, end corrosion, etc." There are usually certain localized areas in a unit or sections of a unit where failures from this cause predominate. The destruction of protective films at such localized areas is due to a relatively high velocity of the circulating medium, together with a turbulent condition and the action of entrained or separated air.

Concentration Cell Action

Many cases of localized corrosion and failure of condenser and heat exchanger tubes are due to local differences in solution concentration or composition which may develop at the metal surface. A break in an otherwise satisfactory protective film may initiate such action. Cracks, crevices or other small openings at baffle or support plates where liquids may seep and become trapped are always a potential source of trouble in this respect.

Deposit Attack

Corrosion of the "deposit attack" type (a special form of "concentration cell" action) is directly due to the settling out or lodgment on the tube wall of sand, mud, coke, stones, wood, shells, flakes of iron scale, etc. Part of the metal surface becomes shielded or protected by the deposit and usually becomes anodic to adjacent metal areas; intense pitting at such shielded areas is likely to occur. If the deposit is of sufficient size to interfere seriously with the flow of the circulating medium, turbulence, air separation and erosion-corrosion of the down-stream side of the tube may take place.

Plug- and Layer-Type Dezincification

Brasses containing less than 85% of copper may undergo corrosion which results finally in the gradual replacement of the brass by a spongy, porous copper deposit. This deposit may occur locally, developing into "plugs" of copper, or it may occur uniformly over the tube surface — in which case it is designated as "layer-type" dezincification. Conditions which favor dezincification of condenser tubes are:

(1) Contact with waters slightly acid in character and of a low degree of aeration.
(2) Relatively low velocity of water over the tube surfaces, or stagnant water in tubes.
(3) Relatively high temperatures.
(4) Certain types of permeable scales on the metal surface.

Galvanic Action

The indiscriminate use of dissimilar metals and alloys in any service, when they make good contact and are also subjected to a conducting medium, may lead to the early failure of one member of the couple. In the design of equipment which is to be used for handling liquids, moist gases or vapors, therefore, the possibility of galvanic corrosion should be given careful thought.

Such are the common causes of trouble. The cures for these troubles may be determined with the aid of Scovill's two other services:

Service in Men, which gives you the benefit, through consultation, of the many years' experience represented by Scovill engineers.

Service in Metals, which gives you complete laboratory and production facilities (as national needs permit) in the working-out of a solution to your problem.

For a further demonstration of *Service in Manuals*, of which the foregoing information is a sample, write us for Scovill's free "Condenser Tube Booklet", containing diagrams, formulae, description of alloys. Address Scovill Manufacturing Company, 17 Mill St., Waterbury, Conn.

THIS IS NUMBER TEN in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

Up where sawmills have to be flown in...

Bowser Engineered Fueling Systems

Installing airports and fueling systems on the route to Alaska operated by Northwest Airlines for the Army Air Forces, was a tough job. The route was largely through such primitive country that ground transportation was useless. For instance, a 24-bed hospital was flown in. So was a sawmill. That gives you an idea of the problems.

Bowser Aviation Fueling Systems were chosen for three major reasons . . .

1. In airport operations in many countries, working under all extremes of conditions, Bowser Systems have proved superior in the delivery of clean, dry, safe fuel.

2. Bowser designs and builds systems to meet virtually every special requirement.

3. Bowser-built equipment has established records for dependability and efficiency in hundreds of industries over scores of years.

Airport fueling systems are a specialized field, of course.

Bowser is equally widely known for its specialized lubricating equipment for the Power industry—turbine oil conditioners, filters and force feed lubricators, for instance.

Operating tests, conducted by impartial experts, have shown that oil, if kept perfectly clean, remains as good as new. Bowser Pressure Filters, working under severe power plant operating conditions have demonstrated their ability to keep oil clean and efficient much longer, thus prolonging the life of the equipment and saving money.

This is important, too—wherever you're located, there's a complete Bowser service organization close to you. BOWSER, INC., Fort Wayne 5, Ind.

Not only has Bowser's war production earned the Army-Navy E... Bowser equipment has helped earn it for scores of other companies.

BOWSER ESTABLISHED 1885

The Name That Means EXACT CONTROL of Liquids

THE "DOCTOR"— McGarvey Eddleman of Allis-Chalmers Norwood Works— is taking a temperature reading during the heat-run test. It's just one precaution that helps Allis-Chalmers build consistently great motors.

What do You Say, Doc?

NO—THAT'S NOT a sick motor. Actually it's a very *healthy* one. But that's something we must know — through generous sample testing — before Allis-Chalmers motors can tackle jobs for you.

Part of the "physical exam" that motor at the left must pass is the heat run test. Bristling with thermometers, the motor runs at full load — and speed and temperature are recorded for every hour.

Five or six hours can tell you a lot about a motor's characteristics —but it takes more like five or six *years* to tell you its *character.*

And it's the test of time in which Allis-Chalmers motors have established that they are *great* motors. That's why you hear so many engineers say: "You can depend on Allis-Chalmers Motors!"

• • •

If you could meet and talk with the men who build Allis-Chalmers motors, you might be surprised to learn how keenly they are aware of the big *personal* stake they have in every motor they build for you.

They know that factory tests to fully pre-determine how well a motor is built *just don't exist;* that there's still no substitute for responsible craftsmanship.

And they know that when they build great motors for you they're making *friends*—and that no company and its workers can have too many of them. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1726

AC VICTORY PEACE

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Fifteen little Yarway Impulse Traps get cooking kettles hotter, sooner, and keep them hot to turn out tons and tons of "Good and Plenty"—popular taste-tempter of the Quaker City Chocolate & Confectionery Company, Inc., Philadelphia.

The picture shows five of the fifteen individually trapped kettles. The Chief Engineer reports, "After 3 years of service, without attention, these Yarway Impulse Traps are still keeping our cooking kettles at peak efficiency."

More than 300,000 Yarways Have Been Purchased

Yarway Trap performance talks. *Quicker heating and greater sustained heating efficiency* soon pay for the installation and continue to return worthwhile profits in plant operating economy. When you consider that their *purchase price* is usually *no more than the cost of repairing an ordinary trap*—why not get Yarway performance for your money?

Then, too, its *small size saves space.* Its *lightweight simplifies installation.* Its unique design with *only one moving part,* and its *rugged bar-stock construction,* keep down maintenance expense. And Yarway Traps are *suitable for wide range of pressures without change of valve or seat.*

A nearby Mill Supply Dealer handles YARWAY IMPULSE TRAPS and will be glad to serve you. Or write for Catalog T-1738.

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YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Lasting Peace Vs. Another Armistice

By ROY F. HENDRICKSON

MORE than five hundred million people in thirty-five countries now live under the grip of the Axis; hungry, cut off from supplies of essentials, medically destitute, their lands occupied, their labor and resources compelled to contribute to the war machines of the enemy. The first problem following front line warfare centers upon urgent relief needs; food, clothing and medicine. This responsibility falls largely upon the United Nations Relief and Rehabilitation Administration (UNRRA).

Some American business men seem concerned over the possibility that the United States proposes to create a world-wide WPA, which it would finance and operate. Others fear heavy drains on available goods, both in raw material and fabricated form, which they depend upon for profitable distribution through private channels here at home. A few individuals possibly associate UNRRA with misdirected, supersized American charity on an international basis.

Any such conception needs to be weighed in the light of these facts:

1. All 44 countries comprising the United Nations and nations associated with them in the war belong to UNRRA. All that have not been invaded contribute in proportion to their national income. It is not an exclusive USA activity, as many assume to be the case whenever large outlays are made from our public treasury.
2. The total underwriting of UNRRA from all member countries amounts to $2,500,000,000; the USA portion to $1,350,000,000. Clearly our commitment is not excessive if it contributes importantly to enduring peace.
3. Far from being theoretical or super-charitable, the UNRRA program is so realistic and essential that it constitutes a vital part of the war program itself, although primarily created to help lay a sound foundation for lasting peace.
4. UNRRA aid goes chiefly into the occupied territories, once they are liberated. Since our enemies give up occupied territories only after the fiercest kind of battling, reoccupation entails considerable relief and rehabilitation to provide, (a) a safe base for further military advancement, (b) an economically safe environment behind the front lines and (c) enough freedom from pestilence and starvation to make it clear that victorious reoccupation does not bring worse chaos and privation than our enemies forced upon the same territories.
5. Immediately following liberation, previously occupied countries will hardly be normal customers for export sales from the USA. On the other hand, what some can buy with funds still remaining in their exiled treasuries, plus what some may secure through UNRRA, will become the means of relaying foundations for peacetime exporting.

In the case of food, clothing, and other supplies, emphasis must be placed on the principle clearly enunciated by Director General Herbert Lehman of helping liberated peoples to help themselves. The frequent use of the expression "relief" alone has given many people the impression that all food, clothing, medical and sanitation supplies, agricultural machinery, industrial equipment and raw materials are to be provided free of charge.

At least three of the European allied countries have more than enough funds to their credit abroad to pay for all they will want to obtain from the United Nations.

Hence, we in UNRRA use the term "relief and rehabilitation" in describing our operation. But "rehabilitation" does not mean reconstruction.

Where, what and when UNRRA will first provide, and under what conditions, depends upon the direction and timing of military efforts and the extent of damage done by invading and retreating forces. We must plan for the liberated areas, country by country, on both a "scorched" and an "unscorched" basis. If physical damage is not great, or if the liberated area has financial resources, UNRRA funds may not be used at all, or only in the sense of a revolving fund—an advance to be repaid—or only to pay for immediate succor items.

To get supplies, UNRRA must go to the allocating agencies established by the United States and the United Kingdom, namely the Combined Boards. There is one for food, one for other production and resources, one for shipping. These boards, whose United States members include Donald Nelson, Judge Marvin Jones and Admiral Emory Land, will consider UNRRA requests for products in short supply in the light of other demands for civilians, for military purposes, for normal exports.

UNRRA will use each country's own existing national procurement agencies for buying supplies. UNRRA will indicate what items it needs and in what quantities.

In the food field, wheat and other cereals, and fats and oils, will dominate the initial flow. Meat, especially canned types not requiring refrigerated transport, dried eggs, dried milk and fish, will be needed, together with dry peas and beans, including soup mixtures with soybean flour, flakes and grits as a base.

Limited quantities of coffee and tea can be supplied. To millions of homes with long, dreary experience with tree barks and leaves as coffee and tea substitutes, the return of the genuine article, even in limited amounts, will truly symbolize victory and liberation. Millions of people are known to be medically destitute, lacking doctors, dentists and medicines. Already at UNRRA's request, FEA and its agent, the Procurement Division of Treasury, are acquiring clothing, used clothing that has been re-conditioned, including salvaged army garments, and new clothing. The clothing and footwear deficit in Europe is mammoth.

In Europe the occupied areas are now fitted to a German war economy. Cutting these areas off suddenly from even the limited benefits they are now receiving presents an immediate and acute problem of relief in most instances. But to reduce the undesirable and costly prolongation of the relief period, means that the liberated areas must be assisted to produce the things wanted by the United Nations—to provide a basis for a fair exchange of the products they can best produce for the items they need and cannot economically produce. The final solution is a major post-war problem—a small but healthy start cannot wait long.

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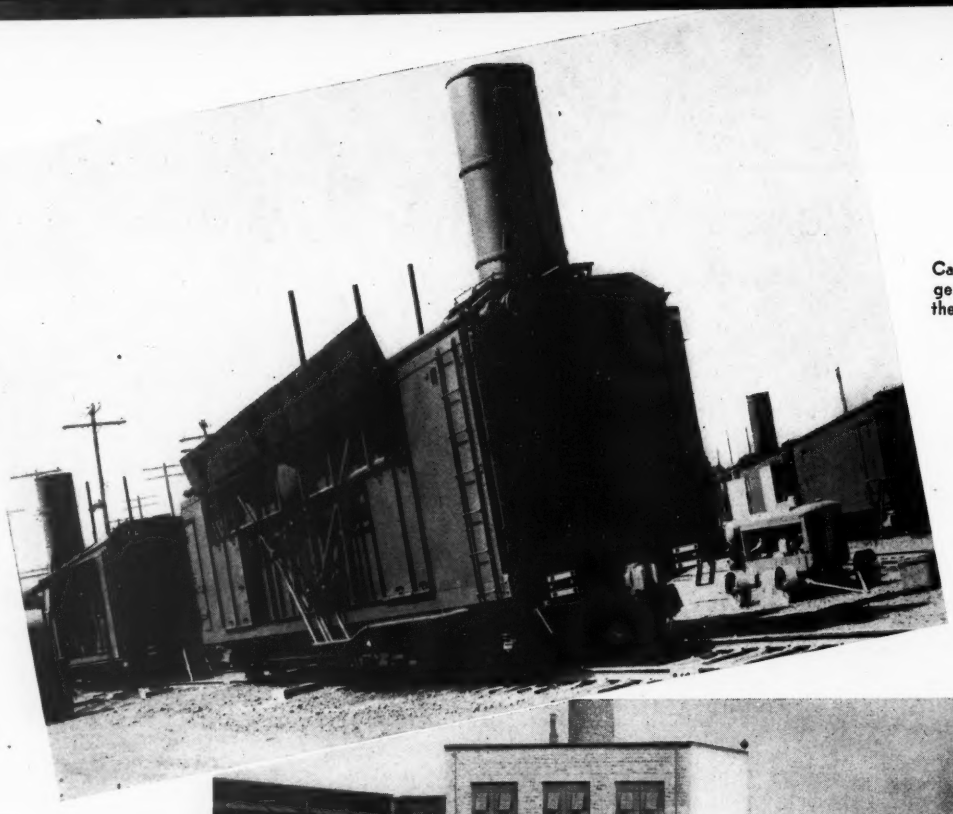
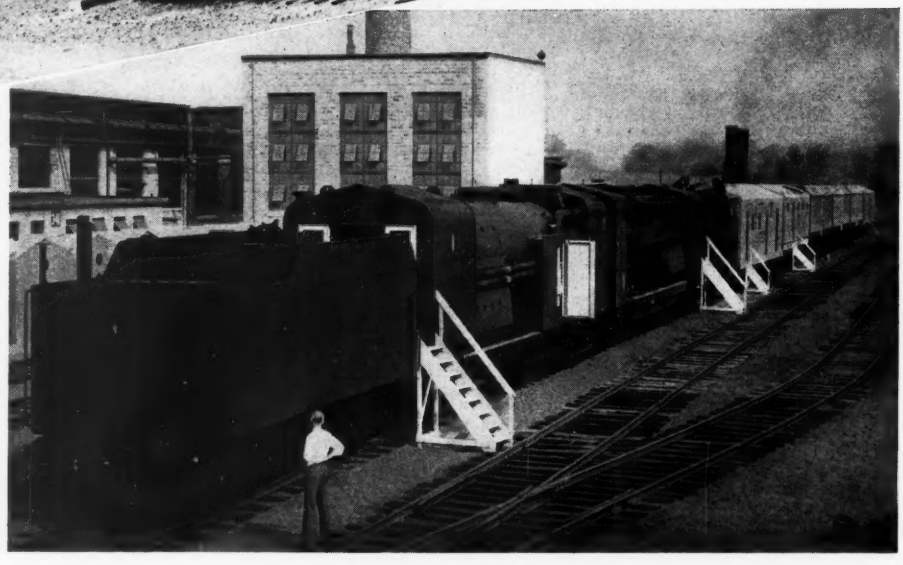
Roy F. Hendrickson is Deputy Director General of UNRRA in charge of the Bureau of Supply. He also supervises UNRRA's agricultural rehabilitation program. Before joining UNRRA Mr. Hendrickson was Director of Distribution of the War Food Administration. Born on a farm in Iowa, educated in Iowa and Minnesota, Mr. Hendrickson served as a reporter and newspaper executive for ten years. He entered government service in 1933 and was successively an assistant in the Office of the Secretary of Agriculture, Director of Economic Information of the Bureau of Agricultural Economics, Director of Personnel for the U. S. Department of Agriculture, Administrator of the Surplus Marketing Administration, the Agricultural Marketing Administration, and the Food Distribution Administration. He was the United States member of the Combined Food Board and chairman of the U. S. Food Requirements and Allocations Committee. He is the author of FOOD "CRISIS", published recently by Doubleday-Doran, an analysis of the world food situation. This article was especially prepared for POWER PLANT ENGINEERING, a member of Business News Service.



Cars containing the steam generating equipment for the eight car, 5000-kw Westinghouse trains



One of the ten car, 3000-kw General Electric trains

POWER-TRAINS

The past two years have seen the initial and subsequent considerable development in mobile steam power plants. The first to be completed were the 10,000 kw trains built by the General Electric Co. for the United States Navy, which were originally intended as a wartime emergency measure to bring power quickly to a locality suddenly deprived of its usual source of supply. These two plants have been in successful operation for several months.

A logical sequence of this development was the development of similar but smaller plants for use in the war-torn and scorched earth regions being continually reoccupied by the allied nations. A considerable number of such "Power-Trains" are now in course of construction. In the photographs on this page are shown two types of such trains. In the top view are shown several boiler cars for the 5000-kw trains being built by Westinghouse. The boilers for these units are 40,000 lb per hr water tube boilers built by Combustion Engineering Co.

In the view below is shown one of the 3000-kw mobile trains built by General Electric Co. The boiler cars of these trains are fire tube, locomotive type boilers designed to operate at 300 psi, 600 F. These ten car trains built by G. E. and the American Car & Foundry Co. consist of a tender car, a locomotive boiler car, a second tender car, a second locomotive boiler car, a switch car, a turbine car, three cooling tower cars and a crew maintenance car. The 5000-kw Westinghouse trains consist of eight cars.

These mobile plants on their own wheels are hauled by railroads to the site, spotted on a single track and require only the connection of steam pipes, water pipes and electric cables all carried on the cars to be ready for operation.

Further data on these trains will be found on page 81.

WITH THE EDITORS

◆ **Destruction**—In reading the various reports about the destruction caused by bombs and the deliberate demolition by the enemy in their withdrawal from the war in Europe, many of us have wondered what happens to power plants in these areas. How effectively are they destroyed and how long would it take to put them back in shape for service? The photograph on this page shows what happened to one such power plant. This pile of rubbish was once the electric generating plant at Scari, Italy. It was reduced to the state shown here by the blasting of Allied bombs in the drive for the Italian town. Note the shell craters and the ruined railroad track alongside of what was once the plant. There is practically nothing left that has any salvage value and it will be obvious to any engineer that it would take many months to restore the power services formerly supplied by this plant by ordinary methods of rebuilding.

Acme Newspictures, Inc.

◆ **Reconstruction** — Looking at this picture, brings home the value of the mobile power plants shown on the opposite page. Such trains can be run along a railroad siding and in a matter of around eight hours can be supplying an ample amount of power for the vital needs of the area while reconstruction proceeds.

While the present mobile power plants are being built to provide the essential needs for power in the devastated areas pending the replacement of the power facilities that have been destroyed, it is quite possible that after the war, such mobile power plants will come into more or less general use for various purposes. Large power companies for example might use a number of them to shift from one area to another to meet seasonal load variations or for emergency use in flooded regions. Such mobile units might be of value in bringing up the load factor on small power systems. Much will be learned about them from their war use, both as regards manufacture and operation. Despite the fact that much of the equipment used in these units is of conventional design, its arrangement on the cars provides many novel problems. The extensive use of air condensers on some of the trains is bound to result in further development of this type of equipment which might be of use in stationary practice in localities where water is scarce.

◆ **Norelco** — One of the interesting commercial developments of this war is the establishment in this country of the North American Philips Co. This company has its origin in the famous Dutch company, N.V. Philips Gloeilampenfabrieken, in Eindhoven, Holland, which for many years was unrivaled in Europe in the radio and lighting field. When the Nazis invaded and seized the Eindhoven plant, it was fortunate that a number of engineers and executives were able to flee from Holland and come to this country and form the American company. Others drawn from the Philips organization in allied and neutral countries added their skill and knowledge to that of the American members of the company's staff.

Previous to that, in 1934, Philips had begun manufacturing activities in this country when the Philips Metalix Corp. was formed to manufacture x-ray tubes and equipment at Mt. Vernon, N. Y. In 1942 when Philips interests in this country organized the North American Philips Co., Metalix became a division of the new company.

In 1939 Philips Eindhoven set up two trusts, one in the United States and one in London. The American trustee is the Hartford National Bank & Trust Co. of Hartford, Conn., and the purpose of this trust was to prevent the Nazis from tampering with the Philips properties in the Western Hemisphere. The stock of Philips Eindhoven itself is publicly held and its stockholders are scattered all over the world. North American Philips, therefore, is something more than a refugee company. The trust which was set up before the war certainly will continue until the war ends and it is claimed that the company will not be governed by the Dutch company after the war is over. There will, however, be a free post-war exchange of patents and research technique among all the Philips interests. Its products are marketed under the trade name of Norelco.

When Holland was invaded in 1940, the British sent destroyers across the channel in the hope of removing about 400 Philips executives and technicians but the cargo was scattered all over the country. The ships could not collect all the men they set out to rescue. Those who reached England, however, came armed with a vast store of technical information, experience and ability, and a plentiful supply of gold guilders. The executives' background was as rich as their backing. Founded in 1891, Philips Eindhoven had become a globe girdling concern by 1939. It had given the world such inventions as the sodium lamp, the pentode tube, the ultra-high pressure mercury vapor lamp. Before the war it sold more radios abroad than all the United States manufacturers exported, and it made nearly 80 per cent of all the incandescent lamp bulbs produced outside the United States. Westinghouse and General Electric still use Philips' patents extensively. The Holland plant alone covered 78 acres and employed 20,000 people.

In the United States, besides forming Philips Metalix in 1933, in 1938 Philips Technical Products, Inc., had been formed here to distribute various Philips products in the United States. Two years later, this setup was succeeded by Philips Export Corp., which had radios manufactured by United States concerns, but under Philips' specifications, for export to Latin America.

So Philips is no fly-by-night outfit. It is a truly great organization. So far, its manufacturing volume in this country is negligible but in view of its background and prestige throughout the world, it will have to be reckoned with seriously.

Power Supply for the Geneva

Part I

Detailed description of power plant supplying electricity and blast furnace air for making steel plate blooms, billets and structurals at new Geneva Works* now being operated by Geneva Steel Co., U. S. Steel subsidiary, for Defense Plant Corporation, just completed at Geneva, Utah . . . Steel mill by-products—blast furnace gas, coke oven gas, coke breeze—supplemented by pulverized coal, generate 1,200,000 lb of 450-psi, 750-F steam for one 50,000-kw turbine generator, three turbo-blowers, and steel mill processes . . . Analysis of design factors . . . Recirculation reservoir and water treatment are features . . . Part II will describe electrical features

By *G. A. Gaffert* *and* *S. L. Chapin*

Sargent & Lundy, Chicago, Illinois

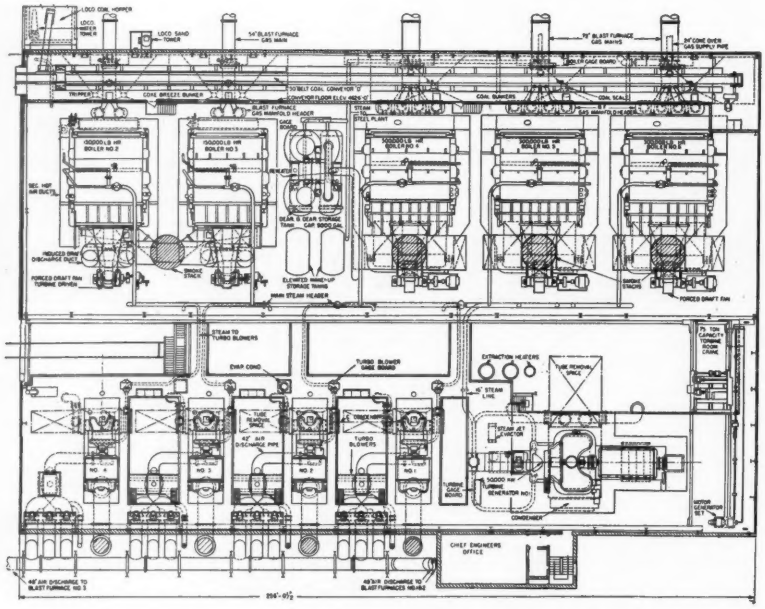


Fig. 1. General arrangement plan of power plant for Geneva Works

DETERMINATION of the type and number of steam generating units for power service in a steel plant is intimately associated with the type and capacity of steel facilities projected. The plan of the new government steel mill at Geneva, Utah, built by Columbia Steel Co. and being operated by Geneva Steel Co., both U. S. Steel subsidiaries is to produce steel plate blooms, billets and structural shapes.

The basic equipments are as follows:

4—Becker Type Underjet Coke Ovens (63 ovens per battery or 252 total)

3—1100 ton Blast Furnaces

9—225 ton Open Hearth Furnaces

1— 45-in. 2-high Slabbing Mill

1—132-in. Plate Mill

1—Structural Mill (32 x 78 in. reversing roughing mill and 26 in. shape mill)

Each of these major facilities has a bearing on the fuel or power supply. Two of the coke ovens are being planned for a mixture of coke oven gas and blast furnace gas firing, while two of the batteries are to be coke oven gas fired only with hot waste gas recirculation.

The blast furnaces are provided with dust catchers, primary washers, and wet precipitators for cleaning all blast furnace gas for stoves, coke oven, and power boilers to 0.01 grains per cu ft dictated by coke oven requirements. Also, the furnaces will operate at an altitude of 4540 ft above mean sea level where the barometric pressure is 12.45 psi gage.

Selection of Operating Pressure and Temperature

In the making of steel, an attempt is made to utilize all by-products or waste products. Blast-furnace gas is first used for underfiring two batteries of coke ovens; approximately 30 per cent is used for heating the stoves, the

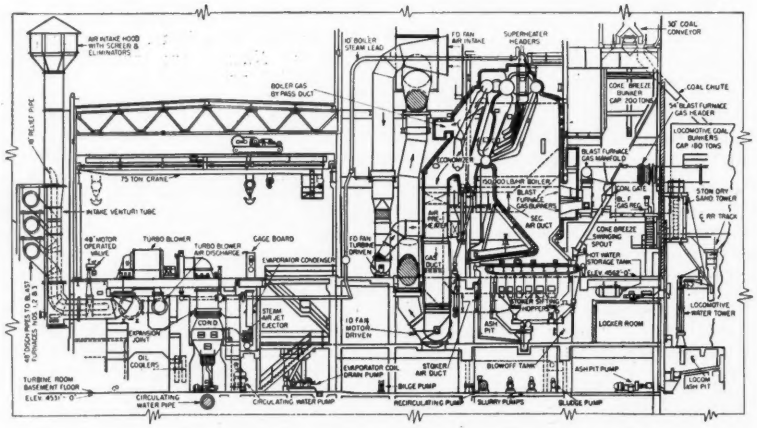


Fig. 2. Partial cross-section through power plant at 150,000-lb-per-hr boilers and turbo-blowers

* See Power for the New Geneva Steel Mill, POWER PLANT ENGINEERING, July, 1943. For detailed discussion of reasons for building the steel mill at Geneva, construction details and general operation of the mill, see Utah Now Producing Steel, by C. H. Vivian, Compressed Air Magazine, February, 1944.

Steel Plant

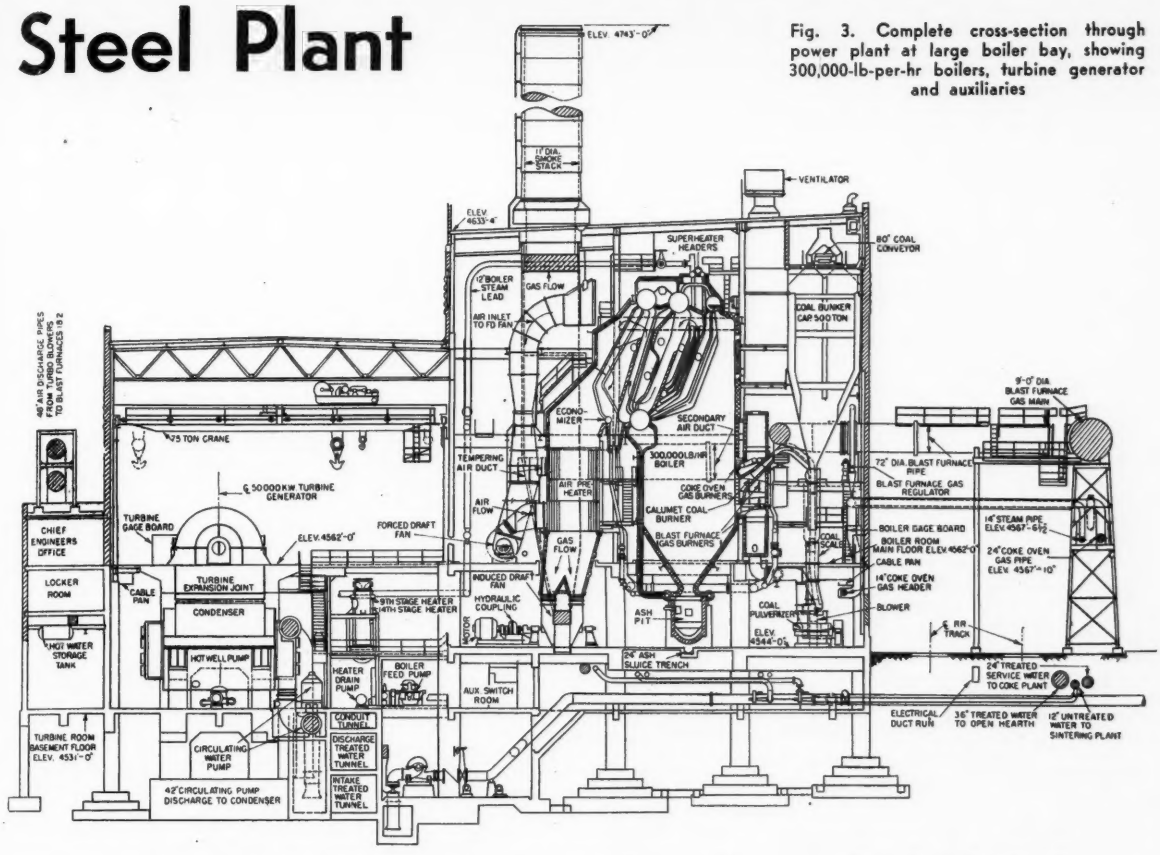


Fig. 3. Complete cross-section through power plant at large boiler bay, showing 300,000-lb-per-hr boilers, turbine generator and auxiliaries

remainder being available for power production in power boilers. Any surplus coke-oven gas remaining after requirements of coke batteries, soaking pits, open hearth furnaces, and reheating furnaces are satisfied, is piped to the power plant for disposal.

In the preparation of coke from coal, there results a small amount of small coke called "coke breeze," which is to be disposed of in power boiler furnaces. Analysis of the demands for power and steam indicates that there will be periods of shortage of by-product and waste fuels. Accordingly, solid fuel —in this case, pulverized coal—capacity is necessary to provide ample steam power. Such a shortage occurs when a blast furnace is cast or when the demands for gas for process coking or open hearth heating leave practically no gas for power.

Coal for coking is obtained from Geneva Mine in Horse Canyon, Emery County, Utah, some 120 miles from the plant site. Coal for power is obtained from the same source. This fuel has a heating value of 13,000 Btu per lb, a moisture content of 5 per cent and 1 per cent sulphur.

From an economic point of view, it did not pay to employ high pressure or temperature for power generation with cheap fuel which is largely a by-product. Further, the design of turbines as built by the turbo-blower manufacturer had not progressed beyond 450 psi, 750 F and new designs would be costly and would occasion considerable delays in starting schedule. This brought up the question of a two-pressure plant, one for power and one for the turbo-blowers. In this case, it was not considered advisable, due to additional equipment required and to reduced power capacity when it was necessary to operate the power turbine on the low pressure boilers. Accordingly, the selection of 450 psi gage, 750 F which is also a power turbine standard, was logical for this plant.

The effect of power surges on the electrical generator, due to characteristic steel mill load, was carefully considered. These occur in quick succession, due largely to reversal of the slabbing mill in rolling an ingot down to a slab. A check was made of the inertia due to momentum of 3600-rpm versus 1800-rpm machines and it was found that an 1800-rpm machine has considerably greater momentum than a 3600-rpm machine of equal capacity. Speed was established at 1800 rpm.

The number of turbo-blowers was obvious—one per blast furnace and a spare unit; i.e. four units in all. The capacity of each was based on the accepted unit for air required as used in the Chicago district, i.e. 52 cu ft of standard air (62 F, 29.96 in. Hg) per lb coke (revised to 62 F and 25.36 Hg = 62 cu ft per lb coke). This was further revised to an intake temperature of 100 F.

Steam Generating Capacity

A careful study of the required steam capacity was made. This involved steam for turbo-blowers, power turbine, steam driven auxiliaries, additions due to extraction cycle and steel plant steam supply. A total of 1,200,000 lb per hr was established.

With coke breeze to burn, stokers were the natural selection. Pulverized coke breeze would consume considerable power with little gain in efficiency. Also, there was little experience with this type of firing. Sufficient coke breeze was available to produce 200,000 lb steam per hr, but no stoker was commercially available. It was decided to divide this into two units. In addition, the smaller boiler units were logically arranged to burn blast furnace gas also, with a total coke breeze and blast-furnace gas steam capacity of 150,000 lb per hr per boiler.

The remainder of capacity, 900,000 lb per hr, was divided into three units, two of which can readily carry full kva load on the turbo-generator. These boilers were necessarily designed to burn three fuels; coke oven gas, blast furnace gas, and pulverized fuel. In case of loss of gas fuel, the power boilers can develop full kva capacity on the turbo-generator, each boiler being equipped with 175,000 lb per hr pulverized fuel capacity or a total solid fuel capacity of 725,000 lb steam per hr (including the stoker fired boilers).

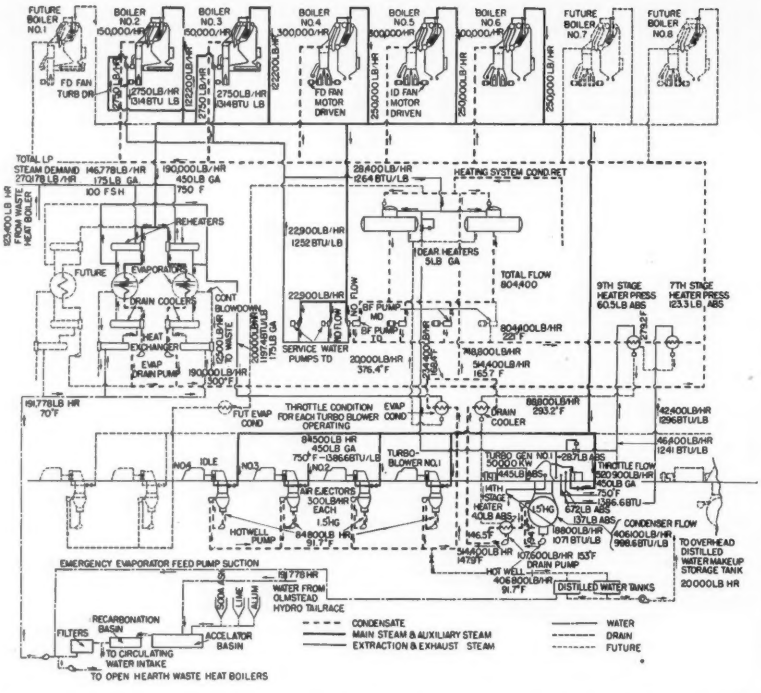


Fig. 4. Heat balance diagram of Geneva Works power plant. Refer to the following table

Table showing Summary of Performance

	Unit	Plant
Generator Output—Kw	50,000	50,000
Water Rate to Throttle—#/Kwhr	10,418	10,986
Heat Rate to Throttle—Btu/Kwhr	11,120	11,936
Overall Boiler Efficiency	80%	80%
Btu/Kwhr Generated	13,900	14,920
Btu/Kwhr to Auxiliary	942	2,242
Btu/Kwhr Output	14,842	17,162
Operating Efficiency Ratio	96%	96%
Btu/Kwhr Sent Out	15,460	17,877
Plant Thermal Efficiency	22.075%	19.090%

Power Plant Arrangement

It was decided to place the shafts of the turbo-blowers perpendicular to the walls to shorten the building and make the length of the turbine room comparable with the boiler room. The main turbine was too long to place parallel to the turbo-blowers but fitted the width of the room for the blowers admirably with suitable allowance for pumps and heaters. A general arrangement plan of the power plant is shown in Fig. 1.

Consideration of arrangement of the boilers showed that concentration of the evaporators and deaeration equipment in a single central bay was practicable. Blast furnace gas supply is through large gas mains. With boilers facing the turbine room, these mains would occupy considerable room coming from the blast furnace area, across the boiler to the firing aisle. Also, with the omission of the curtain wall between boiler room and turbine room, the fuel supply system would probably cause a dirty turbine room. With boilers facing in the opposite direction, gas lines were shorter, coal conveyor was shorter and a decision was made to face the boilers this way.

Boiler Plant

Each large boiler is fired with three fuels; coke oven gas, blast furnace gas, and pulverized coal. The furnace volume is based on blast furnace gas firing with a maximum heat liberation of 22,000 Btu per cu ft per hr. A hopper bottom design is employed with four angular Calumet type pulverized fuel burners per boiler. Four coke oven gas burners and four blast furnace gas burners are also interspaced across the front of the furnace wall; and the preheated air boxes are sectionalized with individual damper control for each fuel.

The economizer is of the drum and vertical tube type to minimize deposition of solid dust particles carried over from the blast furnaces. A tubular type of air heater completes the heat reclaiming surface.

Steam temperature control, consisting of a divided steam circuit, is provided to maintain constant steam temperature from 60 per cent boiler rating to full capacity. Part of the steam is diverted to a coil submerged in the lower drum, desuperheated and mixed under control with the remainder of steam passing normally through the superheater. Leeds and Northrup temperature control mixes these two streams of steam to hold the final temperature constant. It should also be mentioned that the water wall furnace is partially studded up to the pulverized fuel burner zone.

See Fig. 3 for general cross-section through large boiler bay.

The design capacities per boiler on each fuel fired separately are:

Coke Oven Gas 166,000 lb. steam per hr

Blast Furnace Gas ..... 300,000 lb steam per hr

Pulverized Coal 175,000 lb steam per hr

Each 150,000 lb per hr boiler has a divided furnace. The shape of the lower furnace is required for the burning of coke breeze. The normal expansion zone above is used as a furnace for blast furnace gas. Since the water walls are on wide centers, a tile insulated wall is used. Each of these boilers is fired with a 21 ft by 20 ft chain-grate intermediate type stoker. Each of these boilers is equipped with the same type of economizer, air heater, and superheat control as the larger 300,000 lb per hr boilers. In addition, the forced draft fans are turbine-driven and an emergency stoker engine drive is provided. Products of combustion can be removed by by-passing the air heater direct to the stack by natural draft. In this manner, each boiler can develop 50,000 lb per hr to take care of steel mill water service, steel plant steam and essential steam driven auxiliaries.

The actual boiler capacity on each fuel fired separately is as follows:

Blast Furance Gas ....150,000 lb per hr

Coke Breeze .....100,000 lb per hr

See Fig. 2 for plant cross-section at coke breeze boilers and turbo-blowers.

Combustion Control Equipment

The by-product fuels burned in the 300,000 lb per hr boilers, in the order of their descending calorific values, are coke oven gas and blast furnace gas. It was, therefore, decided that these by-product fuels in these boilers should be burned in this order and supplemented as necessary to maintain the steam pressure with purchased fuel; i.e. pulverized coal. Coke breeze is a by-product which must be consumed approximately as made, because of storage facilities. It is the intention, therefore, to burn this fuel more or less as a base fuel on the 150,000 lb per hr boilers.

Coke breeze will be burned in the small boilers at a manually set rate which will approximately keep pace with coke breeze production. Air for burning this fuel will be automatically proportioned to the set rate.

Coke oven gas will be burned in the large boilers at a manually set rate which will be automatically tempered by the availability of this fuel as indicated by the position of the gas holder. Air for burning this fuel will be automatically proportioned to the set rate.

Principal Mechanical Equipment, Power Station, Geneva Works, Geneva Steel Co.

Boilers	The Babcock & Wilcox Co.	The Babcock & Wilcox Co.
Number	3	2
Steaming Capacity—lb/hr	300,000	150,000
Water Heating Surface—sq ft	22,270	12,536
Superheater Surface—sq ft	7,720	5,100
Design Steam Pressure—psi	525	525
Operating Steam Pressure at Superheater Outlet—psi	475	475
Steam Temperature at Superheater Outlet—°F	760	760
Water Temperature at Economizer Inlet—°F	300	300
Fuels Burned	C.C.Gas. B F. Gas & Coal	B.F. Gas & Coke Breeze
Method of Burning Solid Fuel	Pulverizer	Stoker
Type of Boiler	Bent Tube	Bent Tube
Size Boiler Tubes	3¼"	3¼"
Size Superheater Tubes	2"	2"
Superheat Temperature Control	Attemperator	Attemperator

Furnace		
Area Water Cooled Wall—sq ft	4,790	2,542
Volume of Furnace—cu ft	19,100	9,600
Type of Bottom	Hopper	....

Economizer		
Type	Integral	Integral
Area Heating Surface—sq ft	4,420	3,800
Size Tubes	3¼"	3¼"

Air Heater		
Type	Tubular Vertical 2 Sec.	Tubular Vertical
Area Heating Surface—sq ft	25,600	7,700
Sizes Tubes	2½"x18'0"	2½"x14'0"
No. of Rows of Tubes	32	20
No. of Tubes per Row	68	42

Pulverizer	The Babcock & Wilcox Co.
Number per Boiler	1
Type Pulverizer	Air Separation Ball
Capacity—tons/hr	8.75
Make Blower	Sturtevant
Size Driving Motor—hp	200
No. of Burners per boiler	3
Type of Burner	Calumet
Speed of Pulverizer—rpm	95
Speed of Blower—rpm	1760
No. of Feeders per Pulverizer	1
Size Feeder Motor—hp	1½

Stoker	The Babcock & Wilcox Co.
Type	Chain Grate
Size	20'0"x21'0"
Burning Capacity—tons/hr	7.35
Size Driving Motor—hp	7½
No. of Air Zones	7

Gas Burners		
No. B.F. Gas Burners per Boiler	4	2
Type	Intertube	Intertube
Lb Steam per Hour per Burner	75,000	75,000
No. of C.O. Gas Burners per Boiler	4	.....
Type	Intertube	.....
Lb Steam per Hour per Burner	41,500	.....

Induced Draft Fans	American Blower Co.	American Blower Co.
Serving	300,000 lb Blrs.	150,000 lb Blrs.
No. per Boiler	2	1
Capacity at 550 F—cfm free air	184,000	140,000
Static Pressure at 550 F In. H_2O	17.0	14.0
Temp. Flue Gas—F	550	550
Type Drive	S. C. Motor	S. C. Motor
Speed Control	Hyd. Coupling	Hyd. Coupling
Size Coupling	36-in. Class III	36-in. Class II
Size Driving Motor—hp	800	500
Speed Motor—rpm	900	900
Max. Speed Fan—rpm	850	855

Forced Draft Fans	American Blower Co.	American Blower Co.
Serving	300,000 lb Blrs.	150,000 lb Blrs.
No. per Boiler	1	1
Capacity at 100 F—free air cfm	113,500	51,500
Static Pressure—In. H_2O	16.1	13.7
Temp. Air—F	100	100
Type Drive	S. C. Motor	Turbine
Speed Control	Hyd. Coupling	Turbine Speed
Size Coupling	36-in. Class II	...
Size Driver—hp	500	275
Make Turbine	...	Elliott
Steam Pressure—psi	...	450
Steam Temperature—F	...	750
Back Pressure—psi	...	5
Speed Drive—rpm	900	1,160
Max. Speed Fan—rpm	832	1,032

Coal Handling Equipment	Robins Conveying Belt Co.
Capacity with Coal—tons/hr	200
Capacity with Coke Breeze—tons/hr	160
Belt Widths	36" except Conv. D which is 30"

Instrumentation	
Draft Gages	Hays Corp.
Boiler Drum Water Level Recorders	Republic Flow Meters Co.
Indicating Thermometers & Test Wells	Precision Instrument Co. Crosby Steam Gage & Valve Co., and Consolidated
Indicating Pressure Gages	Ashcroft-Hancock Co.
Indicating & Record. Flow Meters	Cochrane Corp.
Liquid Level Recorders	Foxboro Co. Consolidated Ashcroft-Hancock Co.
Recording Pressure Gages	Leeds & Northrup Co.
Potentiometers	Leeds & Northrup Co.
Recording Absolute Pressure Gages	Foxboro Co.
Concentration Recorders	Leeds & Northrup Co.
pH Determiners	Leeds & Northrup Co.
CO_2 Recorders	Leeds & Northrup Co.
Indicating Boiler Feed Pump Flow Meters	Brown Instrument Co.

Miscellaneous Equipment	
Ash Handling Equipment	Allen-Sherman-Hoff Co.
Coke Breeze Gates & Spouts	Henry Pratt Co.
Water Storage Tanks	Leader Iron Works
Miscellaneous Steel Tanks	Leader Iron Works
Gage Boards	Variety Fire Door Co.
Domestic Hot Water Heaters	Bell & Gassett

Breechings and Ductwork	The Lang Co.
Main Steam and Boiler Feed Piping	Midwest Piping & Supply Co.

Boiler Accessories

Soot Blowers—Diamond Power Specialty Co.

Water Columns—Diamond Power Specialty Co.

Safety Valves—Consolidated Ashcroft, Hancock Co.

Superheat Temperature Control—Leeds & Northrup Co.

Suspended Walls and Arches—M. H. Detrick Co.

Coal Scales	Stock Engineering Co.
Serving	300,000 lb Blrs.
No. per Boiler	1
Capacity per Dump—lb	300
Capacity per Hour—tons	9

Evaporators	Corp.
No. of Units	2
Type	Horizontal Submerged Coil
Capacity—lb/hr	100,000
Steam Pressure to coils—psi	450
Steam Temp. to Coils—F	654
Surface—sq ft	1,950
Size Tubes	⅝" x 16 gauge
Vapor Pressure—psi	195

Evaporator Reheaters	Foster-Wheeler Corp.
No. of Units	2
Type	Shell & Tube
Quantity Vapor Reheated—lb/hr	100,000
Surface—sq ft	500

Feed Water Regulators	Northern Equipment Co.	
Serving	300,000 lb Blrs	150,000 lb Blrs
Number	3	2
Size	6"	4"
Type	Copes-Relay-operated Flowmatic	Copes-Relay-operated Flowmatic

Chemical Feed Pumps	Milton Roy
Turbine Oil Pumps & Tanks	Bowser, Inc.
Turbine Oil Purifiers	DeLaval Separator Co.
Stoker Engine	Troy Engine & Machine Co.

Turbine Room Crane	Whiting Corp.
Span	70'0"
Capacity Main Hook—tons	75
Capacity Aux. Hook—tons	10
Main Hoist Speed—ft/min	5

Untreated Service Water Pumps	Ingersoll-Rand Co.
No. of Units	2
Capacity—gpm	14,000
Head—ft	180
Size Pump	18" Single Stage
Driver	Motor
Size Driver—hp	800
Speed Unit—rpm	880

Evaporator Drain Cooler	Foster-Wheeler Corp.
No. of Units	2
Type	Shell & Tube
Surface—sq ft	180

Evaporator Blowdown Heat Exchanger	Foster-Wheeler Corp.
No. of Units	2
Type	Shell & Tube
Surface—sq ft	180

Building Foundations	Geo. E. Fuller Co.
Bilge Pumps	Chicago Pump Co.

Combustion Control Equipment	Republic Flow Meters Co.
No. of Fuels Controlled	3
Type of System	Hydraulically actuated—pneumatic loading

Recarbonation Equipment	Infilco, Inc.
Number of Dust Traps	1
Type of Dust Trap	Buell Cyclone
No. of Scrubbers	2
Size Compressor	Nash Hytor L-4

Air Compressors	Penn. Pump & Compressor Corp.
No. of Units	2
Type	2 Stage—Duplex
Capacity—cfm	499
Discharge Pressure—psi	100
Speed—rpm	450
Type Drive	Synchronous Motor
Size Motor—hp	100

Heater Drain Cooler	Whitlock Coil Pipe Co.
No. of Units	1
Type	Straight Tube Floating Head
Surface—sq ft	525
Water Quantity—lb/hr	525,000
Drain Quantity—lb/hr	84,350

Evaporator Condenser	Whitlock Coil Pipe Co.
No. of Units	1
Type	Straight Tube Floating Head
Surface—sq ft	372
Water Quantity—lb/hr	300,000
Steam Condensed—lb/hr	40,000

PRINCIPAL MECHANICAL EQUIPMENT—GENEVA WORKS

Turbo-Blowers	Ingersoll-Rand Co.
Number	4
Type	Centrifugal, Turbine driven
Discharge Capacity at 100 F—cfm	95,000
Discharge Pressure—psi	35
Turbine Throttle Pressure—psi	450
Turbine Throttle Temperature—F	750
Turbine Back Pressure—Ins. Hg	1½
No. Stages in Blower	5
No. Stages in Turbine	12
Speed Unit—rpm	2,820
No. of Oil Coolers	2

Turbine Generator	General Electric Co.
Type	Impulse
Capacity—kw	50,000
Power Factor—%	80
Kva	62,500
Voltage	13,800
Current	3 phase, 60 cycle
Speed—rpm	1,800
Exciter Capacity—kw	200
Exciter Voltage	250
Steam Pressure at Throttle—psi	450
Steam Temp. at Throttle—F	750
Back Pressure—In. Hg	1½
No. of Bleeding Points	4
Throttle Water Rate—Full Load—lb/kwhr	10.15
Generator Air Cooler Surface—sq ft	16,450

Traveling Screens	Chain Belt Co.
Number	2
Width (nominal)	10'0"
Centers	26'0"

Deaerating Heaters	Permutit Co.
No. of Units	2
Quantity of Water—lb/hr	600,000
Water Temp. In—F	140
Water Temp. Out—F	Sat. Temperature
Steam Pressure—psi abs	20
Storage Capacity—lb	72,000
No. Vent Condensers per Heater	1
Type	Straight Tube Floating Head
Surface—sq ft	300

Condensing Equipment	Worthington Pump&Mchy.Corp.	Ingersoll-Rand Co.
Serving	Turbo-Generator	Turbo-Blowers
No. of Condensers	1	4
Type	Surface—Two Pass	Surface—Two Pass
Surface—sq ft	50,000	10,000
Size Tubes	18 Ga x ⅞" x 24'0"	18 Ga x ⅞" x 16'0"
Tube Number and Material	Muntz 9,120	Muntz 2,730
Steam Condensed—lb/hr	400,000	88,600
No. Hotwell Pumps per unit	2	2
Size Hotwell Pumps	6"—3 stage	3"—2 stage
Capacity—gpm	1,200	225
Head—ft	175	175
Size Motor—hp	100	20
Speed—rpm	1,150	1,760
No. S.W. Air Pumps per unit	1	1
No. Elements per Pump	2	2
No. Stages per Element	2	2
Circ. Water per Condenser—gpm	51,000	14,600

Circulating Water Pumps	Pomona Pump Co.	Pomona Pump Co.
Serving	Turbo-Generator	Turbo-Blowers
Number of Pumps	2	3
Type	Vertical Submerged	Vertical Submerged
Size Discharge	42"	36"
Capacity—gpm	26,000	20,000
Head—ft	35	29
Size Motor—hp	300	250
Speed—rpm	585	700

Boiler Feed Pumps	Ingersoll-Rand Co.	Ingersoll-Rand Co.
No. of Units	2	1
Capacity—lb/hr	600,000	600,000
Discharge Pressure—psi	675	675
Size of Pump	6"—6 stage	6"—6 stage
Driver	Motor	Elliott Turbine
Size of Driver—hp	700	634
Speed of Unit—rpm	3,550	3,550
Turbine Throttle Pressure—psi	.....	450
Turbine Throttle Temp.—F.	.....	750
Backpressure—psi	.....	5
Temp. Water Pumped—F	230	230

Closed Feed Water Heaters	Whitlock Coil Pipe Co.		
Service	7 stage	9 stage	14 stage
No. of Units	1	1	1
Type	Vert-Floating Head	Vert-Floating Head	Vert-Floating Head
Surface—sq ft	2,150	2,390	2,100

Water Quantity—lb/hr	750,000	750,000	425,000
Water Temp. In—F	280	220	94
Water Temp. Out—F	330	280	146
Steam Pressure—psi abs.	123	60.7	3.96
Tube Material	Steel	Steel	Steel
Design Steam Pressure—psi	225	150	100
Design Water Pressure—psi	900	900	100

Miscellaneous Pumps	Ingersoll-Rand Co.	Ingersoll-Rand Co.
Service	Makeup	Evaporator Feed
No. of Units	2	2
Type	2"—Single Stage	3"—2 Stage
Capacity—gpm	200	500
Head—ft	160	240 lb
Size Motor—hp	15	125
Speed—rpm	3,485	3,540

Miscellaneous Pumps	Ingersoll-Rand Co.	Ingersoll-Rand Co.
Service	Heater Drain	Fire
No. of Units	2	2
Type	2"—2 Stage	5"—Single Stage
Capacity—gpm	300	1,000
Head—psi	97.5	125
Driver	Motor	Elliott Turbine
Size Driver—hp	40	93
Speed Unit—rpm	1,765	3,500

Evaporator Coil Drain Pumps	Ingersoll-Rand Co.	Ingersoll-Rand Co.
Number of Units	2	1
Capacity—lb/hr	120,000	120,000
Discharge Pressure—psi	675	675
Suction Pressure—psi	450	450
Size of Pump	2" Single Stage	2" Single Stage
Driver	Motor	Elliott Turbine
Size of Driver—hp	100	77
Speed of Unit—rpm	3,550	3,550
Turb. Throttle Press.—psi	.....	450
Temp. Water Pumped—F	330	330

Treated Service Water Pumps	Ingersoll-Rand Co.	Ingersoll-Rand Co.
Number of Units	1	2
Capacity—gpm	23,000	23,000
Head—ft	180	180
Size of Pump	24" Single Stage	24" Single Stage
Driver	Motor	Elliott Turbine
Size Driver—hp	1,250	1,162
Speed Pump—rpm	700	700
Speed Driver—rpm	700	4,000
Turb. Throttle Pressure—psi	.....	450

EQUIPMENT IN WATER TREATING PLANT

Water Softening Equipment	Infilco, Inc.
Type of Softener	Sludge Blanket
Number of Basins	2
Diameter of Basins	54'0"
Capacity Each Basin—gpm	4,150
Size of Stirring Motor hp	10
Number of Lime Feeders	3
Capacity of Lime Feeders (max.)—lb/hr	500
Number of Soda Ash Feeders	3
Capacity of Soda Ash Feeders(max.)—lb/hr	200
Number of Alum Feeders	3
Capacity of Alum Feeders (max.)—lb/hr	200

Water Filters	Infilco, Inc.
Number	3
Size	11'0" x 11'0"
Capacity Each—gpm	365
Filter Material	Anthrafilt

Chemical Conveying Equipment	Holly Pneumatic Systems
Capacity on Pebble Lime—tons/hr	7½
Type Receiver Discharge	Rotary Lock
Type Vacuum Machine	Roots-Connersville
Make and Type Conveyors	Jeffrey-Screw

Sludge Dewatering Equipment....Dorr Co.

Sludge Conveyor	Link-Belt Co.
Type	Retractable,Screw
Capacity	9"

Filter Backwash Pump	Ingersoll-Rand Co.
Number	1
Capacity—gpm	1,500
Head—ft	30
Speed—rpm	1,170

Sludge Pumps.....Chicago Pump Co.

Bilge Pumps.....Chicago Pump Co.

Open Hearth Treated Water Pumps
Allis-Chalmers Mfg. Co.

Miscellaneous Equipment	
Sulphuric Acid Feeding Equipment	Omega Machine Works
Chlorination Equipment	Wallace & Tiernan
Laboratory Furniture	Sheldon Mfg. Co.

EQUIPMENT IN DOMESTIC WATER TREATING PLANT

Water Treating Equipment	Permutit Co.
Type	Automatic Zeolite
No. of Softeners	2
Capacity Fully Softened Water—gpm	415
Conditioned Water—gpm	750
Hypochlorinators	2—Wallace & Tiernan

Domestic Water Pumps.	Allis-Chalmers Mfg. Co.
Number	2
Capacity (each)—gpm	750
Head—ft	230
Speed—rpm	3,550

EQUIPMENT IN DEER CREEK PUMP HOUSE

Traveling Screen	Chain Belt Co.
Number	1
Width (nominal)	4'0"
Centers	14'0"

Water Supply Pumps	Pomona Pump Co.
Number	2
Type	Vert. Submerged
Capacity (each)—gpm	5,000
Head—ft	73

Ventilation Equipment in Switch House	American Blower Co.

Blast furnace gas will be burned as required to maintain the steam pressure. The burning rate will be automatically tempered by the availability of this fuel as indicated by the position of the gas holder. Air for burning this fuel will be automatically proportioned to the controlled rate.

When the rate of combustion of the three foregoing fuels is not sufficient to maintain the steam pressure, the operators will be so advised through an alarm system. Pulverizers on the large boilers, as needed to maintain the steam pressure, will be started manually. Pulverizer rating will be controlled by the steam pressure controller above a minimum rating below which it is not stable. Air for burning this fuel will be automatically proportioned to the controlled rate.

Provision has been made so that any or all of the fuels on any boiler can be burned at a manually set rate controlled from the individual boiler control boards. Under this system of operation, air is proportioned automatically to the individual fuels.

Provision is also made so that each individual function; i.e., the control of each regulator for each piece of controlled equipment, damper, fan, stoker speed, etc., can be manually controlled from each boiler board independently of each other function. This method of control is for emergency use only.

Draft Equipment

Because of the low heating value of blast furnace gas, a considerable volume must be burned, resulting in approximately twice the required induced draft fan capacity as compared with solid fuel. Two induced draft fans are required per large boiler. The problem of parallel fan operation suggested turbine, variable speed motor, or hydraulic coupling drive. A careful check on ability of the deaerating heaters to condense steam at fractional to full plant load indicated that even with high efficiency turbine drives, this was not possible. Hydraulic couplings and constant speed motors were finally selected for all induced fan drives. Each induced draft fan is provided with its own coupling, circulating oil pump, oil cooler, and speed regulator.

The forced draft fans on the large boilers are similarly driven by constant speed motors and hydraulic couplings. For reasons of safety in protection of water cooled steel plant equipment, the forced draft fans on the 150,000 lb per hr boilers are steam turbine driven.

Coal and Ash Handling

A combined coal and coke breeze handling system of the belt type was developed for the ultimate station. A 200-ton-per-hr coal handling system which will also handle coke breeze at 160 tons per hr will permit coaling in one 8-hr shift and was considered satisfactory. The coal is dumped in a full car length track hopper onto Conveyor A. Conveyor B transports the coal sideways to Conveyor C which feeds the crusher. Coal discharged from, or by-passed around the crusher, passes to Conveyor D (Fig. 1), which feeds the tripper, and can be set to travel over either set of boiler bunkers. On the stoker fired boilers, stored coal is fed through spout swingers for even distribution. In the large boilers, it is fed to a single pulverizing mill.

By manipulation of a gate near coal bunker No. 2, coal may also be diverted to an elevated external coal bunker for locomotive use.

Blast furnace gas dust and pulverized coal ash are collected in a water sealed ash hopper. It is sluiced to an external concrete ash tank. Stoker ash is similarly sluiced to storage. All water used for sluicing is returned to internal pump basin and recirculated, the makeup water being small. Dust and siftings are removed from last pass, economizer hoppers and stoker hoppers. A locomotive crane reclaims the ash from a side track and loads it into rail cars for removal.

Locomotive ash is also removed by dumping into a track hopper while the locomotive is being coaled. Ash is sluiced to a pit and is pumped to the outside ash sluice pit and reclaimed.

Turbine Generator Set

The turbine, rated at 50,000 kw, operates at 1800 rpm and consists of 17 impulse stages. The turbine drives a 50,000-kw, 800 per cent pf, 3-phase, 60-cycle, 13,800-v generator, complete with direct-connected 200-kw, 250-v direct-current exciter with a 4-kw, 250-v pilot exciter. The generator is protected by automatic CO_2 equipment. The turbine has ample capacity to drive the generator at full rated kva at unity power factor. It is arranged for four points of extraction; namely, at the seventh, ninth, eleventh, and fourteenth stages, the eleventh stage feeding the deaerator at loads above 31,000 kw. Extraction steam condensate from the seventh stage heater is flashed to the ninth stage heater and from the latter through a drain cooler to the low pressure heater. Drainage from the fourteenth stage heater is pumped into the heater condensate discharge line. See heat balance, Fig. 4.

If the evaporator plant, rated at 200,000 lb per hr is out of service, a pressure reducing and desuperheating station is brought into service. The waste heat boilers in the open hearth plant are connected by piping with the evaporator vapor line and supply steam to the coke oven gas exhausters, miscellaneous steam service and heating steam. Vapor from the evaporator before the reheater is also piped to an evaporator condenser in the turbo-blower condensate cycle to furnish makeup water for the high pressure cycle.

Recirculation Reservoir

While the location of the steel making facilities is ideal with respect to iron ore, coal and limestone, it is not so fortunate in the supply of adequate water. Both cooling towers and a recirculating basin were considered.

It would require 48 induced draft cooling tower fans arranged in a double battery of 45 ft by 330 ft plan dimensions to cool the circulating water, involving 1500 hp of motors. It was economically cheaper to develop a cooling basin. The return circulating water is conducted to the north end of the basin in a separate channel. Also, the intake is through a deep channel to the south end for maximum separation. A total area of some 13,617,500 sq ft (312 acres) surface is developed. Average bottom is at elevation 4520 ft and maximum operating level has been set at 4528 ft. The intake has been deepened to elevation 4508 ft at the crib house to provide adequate flow area. It is expected that operation in the steel plant can be carried on with the reservoir level down to 4522 ft. Concrete tunnels, arranged one above the other, carry the circulating water to and from the water plant.

Makeup water is taken from the tailrace of the Olmstead Hydro Plant through screens to a pump chamber. It is lifted to the crest of a nearby hill some 500 ft away by two vertical, mixed-flow pumps (5000 gpm at 63 ft) and flows by gravity to the water treatment plant on the property some five miles away.

Water Treatment Plant

It was evident at an early date that there was not room enough inside the power plant to develop a treatment plant for the reservoir as well as boiler feed makeup. A separate building was therefore planned. The plant is basically for softening makeup water from the hydro plant to eliminate or reduce calcium hardness with some reduction in magnesium.

Raw water is conducted through two Venturi tubes with gate valve control on discharge for equalizing or biasing flow. Flow controllers actuate the amount of lime, alum and soda ash fed to the external accelerator basins. Herein the chemicals are dissolved and the effluent overflows to a recarbonation basis inside the treatment plant where the pH value is restored using sulphuric acid or CO_2 gas. The treated makeup water is then discharged to the intake tunnel, as it is fairly cool water. A small portion (some 510 gpm) is diverted to a clarifying sand filter and clear well basin. This is used as evaporator feed for the power station evaporators and also as feed to the waste heat boilers in the open hearth plant.

Sludge is accumulated in the bottom of each accelerator basin and withdrawn to a sludge pit in the building basement. It is removed by sludge pumps which elevate it (8 per cent solids) to a Dorr Thickener. The latter supplies a Bird centrifuge which reduces the water to 40 per cent by weight (60 per cent solids). It is then discharged to rail cars. All chemicals are elevated from rail cars pneumatically, distributed by screw conveyors and flow by gravity to their respective feeders.

(To be continued)

Governing Requirements for
EXTRACTION TURBINES

Variation in power load combined with changes in bled steam requirements have necessitated the development of governing mechanism for extraction turbines that will maintain virtually constant speed under all combinations of these changes. The principles of such a governor are described here

By O. N. BRYANT Westinghouse Electric & Mfg. Co.

IN THE ECONOMICS of power generation, engineers have formulated and proved to their satisfaction in actual practice the general rule that power is generated most efficiently when the plant makes use of the exhaust steam from the turbine. For such uses as the heating of buildings, industrial cooking processes, or any other kind of heating that does not require temperatures above those obtainable from the exhaust of the turbine, exhaust steam is usually just as effective as so-called live steam directly from the boiler.

It has been found that by raising the steam pressure considerably higher

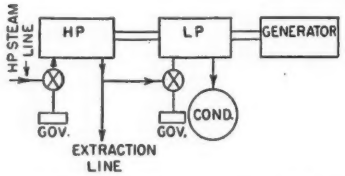


Fig. 1. Diagrammatic arrangement of extraction turbine

than that for heating or process use, the extra heat put into the steam can nearly all (75 to 85 per cent) be put into power. When no practical use can be made of the exhaust steam, however, it must be condensed with cold water. Less steam is required for generating the power, but all the heat in the exhaust steam is wasted. Thus, only from 20 to 30 per cent is turned into power.

Unfortunately, the demand for power from the turbine seldom coincides with the need for exhaust steam for heating and process work. Heating requirements depend upon the season of the year and upon the daily temperature. Processes often have no relation to power requirements. While the proper selection of turbines for particular requirements will not be treated in detail in this article, it may be stated that in general some one of the following arrangements is used:

1. Use a non-condensing turbine to utilize the power available in the steam which is used for heating and processes, and buy any additional power from a public utility system.

2. Use a non-condensing turbine as above but generate the additional power with a condensing turbine (or Diesel plant).

3. Use an extraction turbine, which is really a non-condensing turbine combined with a condensing turbine, all in one casing. This makes an ideal application for many industrial plants.

Extraction Turbine Arrangement

In the discussion which follows, attention will be given to the problems encountered in providing the last arrangement. An extraction turbine is an ordinary turbine which has a partition part way down from the inlet end which divides it into a high pressure and a low pressure section. By this arrangement, steam can pass out at the extraction line for heating or process use or it can go to the low pressure section through the extraction steam chest or grid valve, from which it finally passes into the condenser where it is condensed into water.

Steam which goes through both sections will produce more power than that which passes only through the high pressure section, and steam which is extracted will produce some power as it passes through the high pressure section. Thus if the amount of steam extracted is suddenly increased, but no change is desired in the amount of power being produced by the whole turbine, steam flow into the high pressure end must be increased (since otherwise the total power would decrease if the only change made were the closing of the low pressure valves) and at the same time the steam flow through the low pressure section must be decreased. This is done because the high pressure power will increase, so the low pressure power must be reduced an equal amount to keep the same total value.

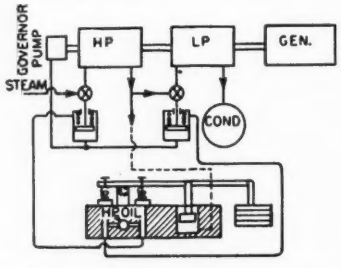


Fig. 2. Pressure-compensated control of extraction turbine

If no extraction steam chest were provided, it would still be possible to extract steam at an intermediate point, but much more serious limitations would be placed upon the pressure at the extraction point and upon the amount of steam which could be extracted. This is because the pressure at any given point in a turbine is roughly proportional to the rate at which steam is flowing through it.

Steam and Power Load Relations

By referring to Fig. 1, it will be seen that if the extraction valve were held wide open, the pressure at the extraction line would be less than the desired value except when the load carried by the turbine is quite large. By partially closing this valve we can raise the pressure in the extraction line to the desired value even though the pressure beyond the valve is very low.

When it is necessary to change the turbine load, while maintaining a fixed flow of steam to the extraction line, it is evident that both the high pressure steam chest valves and the extraction valves must move in the same direction, and must change the steam flow an equal amount.

When it is necessary to change the amount of steam extracted while holding a fixed turbine load, the high pressure valves must move in one direction while the low pressure valves move in the opposite direction, usually at a different rate. The rate at which the high pressure valves move, compared with the rate at which the low pressure valves move depends upon the steam rate (pounds of steam used per kilowatthour) of the high pressure section compared with that of the low pressure section.

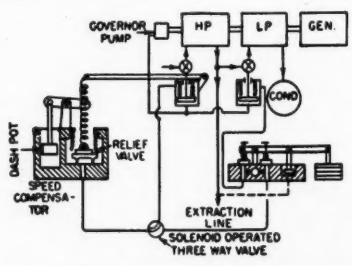


Fig. 3. Speed-compensated control of extraction turbine

Specific Examples

This can best be explained by assuming specific examples and referring to the curve in Fig. 4.

If the extraction pressure is 50 psi and the throttle pressure is 500 psi, the curve shows that the low pressure section produces 51 per cent of the total power while the high pressure section produces 49 per cent of the total power produced by steam which passes completely through the turbine. In this case, the steam rates of the two sections will be nearly equal, so that the high pressure valve will increase steam flow just about as fast as the low pressure valve will decrease its steam flow, when steam is extracted from the turbine.

Now suppose that steam is to be extracted at 250 psi in a turbine having 500 psi throttle pressure. Then $P_2 \div P_1 = 0.50$, and low pressure power $\div$ total power $= 0.82$. Then high pressure power $\div$ total power $= 0.18$. Hence the high pressure steam rate $\div$ low pressure steam rate $= 0.82 \div 0.18 = 4.5$, so that the high pressure valve must increase its flow 4½ times as fast as the low pressure valve decreases its

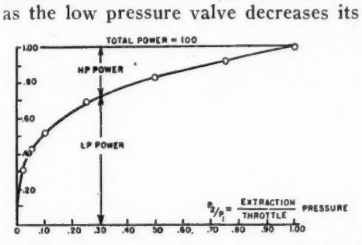


Fig. 4. Curve illustrating division of load between high and low pressure cylinders with variation in ratio of extraction to throttle pressures

flow when more steam is extracted from the turbine.

Design Conditions Give Best Results

It should be understood that each turbine is designed for the particular steam inlet pressure, extraction pressure, and exhaust pressure which the user desires. It is not feasible to deviate very far from these conditions if economical operation is desired. Many turbine users think they are wise to ask for a much higher extraction pressure than they actually need just to be on the safe side. This is poor policy for several reasons:

a. It reduces the power obtained from the extracted steam because the high pressure section is less efficient.

b. It reduces the total power which can be obtained because the low pressure valves and low pressure blading will pass less steam at the lower actual operating pressure.

c. It destroys the balanced relation between the pressure regulator and the corresponding steam flows to the high pressure and low pressure sections. Then the load or speed will be changed as extraction demand changes, instead of remaining constant.

Figure 1 indicates that the two steam chests must respond to speed variation (or to the motion of the speed changer) by an equal amount of steam flow, and that they must respond to variations in extracted steam flow by proportional amounts but in opposite directions.

In certain industrial plants which are not connected to public utility power lines, it is nevertheless very important to maintain the frequency of their power supply very nearly constant. In paper mills, for example, any sudden change in frequency may tear the soft sheet of paper in the paper machine, while a gradual change in frequency causes the average thickness of the paper to change. In such mills, the demand for extraction steam is usually heavy, but variable.

Governor Requirements

Experience has demonstrated that such plants require a governor which holds the frequency very nearly constant even though the turbine load may vary by a large amount.

The hydraulic governor which is often used on turbines of this type holds the valves in a position dependent upon the pressure difference acting upon the relay sleeve. As the pressure is raised below the relay, the governor moves the valves toward their closed position. The same effect can be obtained by decreasing the pressure above the relay while holding the lower or speed-responsive pressure constant.

As shown in Fig. 3, the speed-compensator is a relief valve which has a spring attached to the governor piston. As the valves move toward their closed position, the spring pulls upward on the relief valve, causing it to hold a decreasing oil pressure in the space above the governor relay sleeve. It is possible to adjust the spring scale so that the pressure above the relay falls just as fast as is necessary to keep the piston moving toward the closed position of the valves.

When this is done, no change in governing oil pressure is required to move the valves from the open to the closed position, hence no speed change is required, and the governor is said to be "isochronous."

The dashpot prevents the spring-load on the relief valve from changing very rapidly even though the governor piston moves very quickly. This prevents the governor from moving too far when the turbine load changes and thus avoids hunting. The speed of the dashpot is adjusted to respond as quickly as possible while still preventing hunting.

Adjustment of the speed-compensator spring is seldom so made that the governor will be truly isochronous. Ordinarily from 50 to 75 rpm speed variation is allowed for the full valve travel, although this is not needed unless two or more such turbines must operate in parallel.

When a turbine is equipped with a speed-compensator, it is not necessary to use the control pressure from the extraction pressure regulator to affect the governor. Instead the regulator is permitted to affect only the extraction governor. Then when an increase in demand for extraction steam occurs, the low pressure valves are moved in the closing direction by the regulator. This reduces the turbine output so that the speed falls slightly, causing the governor to open the high pressure valves enough to balance the new load. Then the speed-compensator dashpot moves and restores the turbine speed to approximately the original value.

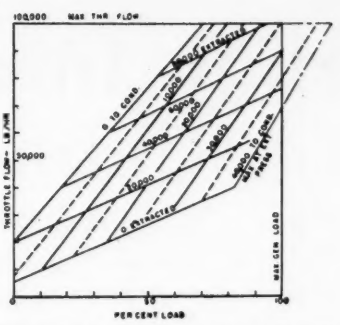


Fig. 5. Variation of steam flow with power load carried on extraction turbine

Certain modern types of governors can be isochronous, and still be affected by the pressure from the extraction pressure regulator. This is better because the speed is held more nearly constant at all times even though the demand for process steam changes suddenly.

When a turbine with a speed compensator is operated in parallel with other turbines which have normal speed variation, it will be found that nearly all variation in total plant load will be taken by this one unit because it holds the speed so nearly constant that there is no reason for the governors of the other turbines to move their valves. It is for this reason that speed compensators are not used except in those cases in which the turbine is large enough to take the entire plant load variation which may occur suddenly.

Columbus & Southern Ohio To Expand Picway Station

COLUMBUS & SOUTHERN OHIO ELECTRIC CO., 215 North Front St., Columbus, Ohio, has approved plans for extensions in Picway steam-electric generating plant at Lockburne, Ohio, primarily for expansion in steam division. An award for structural steel framing, including erection, has been let to Case Crane & Kilbourn Jacobs Co., East Lincoln and North 4th Sts., Columbus, and work will be placed under way soon. Project has a priority rating. Contract for new high-pressure boiler and auxiliary equipment has been awarded to Foster Wheeler Corp., New York. Awards for other required equipment are scheduled to be made soon. Entire project is estimated to cost about $1,300,000, and is scheduled for completion, it is stated, early in 1945.

High Interrupting Capacity Fuses

By H. H. FAHNOE

Protective Devices Engineer
Westinghouse Electric & Manufacturing Co.

As the author of this article points out, at no time during the history of the electrical era has there been more interest in the subject than at the present time. For several reasons, which he explains, the lowly fuse is beginning to attain the recognition it justly deserves. Despite its simplicity, the fuse is a highly reliable protective device and one which when properly installed takes its place alongside the circuit breaker in establishing the reliability of the system as a whole. Although this discussion deals primarily with high voltage, high capacity fuses used on large power systems, the principles involved are the same for fuses of all types and sizes and for this reason Mr. Fahnoe's discussion should be of interest to all operating men. Mr. Fahnoe first presented this at the recent Missouri Valley Electric Association meeting at Kansas City

FUSES are receiving more attention from electrical engineers, today, than at any time during the history of the electrical era. Why is it that a device which only 10 or 15 yr ago was considered a "has been" protective device should now be recognized as a real protective device with innumerable applications?

While the scarcity of critical materials due to the war may have something to do with the present popularity of the fuse, since fuses use very little critical material and provide excellent protection in the new industries, the phenomenal increase in the use of fuses cannot be attributed entirely to the war emergency. The trend toward the widespread use of fuses for providing low cost short circuit protection has been evident for about 10 yr. Considerable research work coupled with development work in the high power testing laboratories resulted in new types of power fuses that eliminated the disadvantages of earlier forms of fuses. At present, fuses are available for every sound application on any system regardless of size.

Fuse or Circuit Breaker

There has been considerable discussion as to the relative merits of fuses vs circuit breakers, but there need be no conflict in this respect since the selection of one device or the other can be made on a sound engineering basis as well as from an economic viewpoint. There are logical reasons for the application of both types of devices.

A brief review of the fundamental differences in the two devices will enable the engineer to make the proper selection in any particular case.

A fuse may be defined as an overcurrent protective device with a current responsive element which is destroyed by an excessive current, combined with an interrupting means for interrupting the current which destroyed the current responsive element. To restore service it is then necessary to replace the current responsive element or the complete fuse consisting of the current responsive element and interrupting means.

A circuit breaker may be arbitrarily defined as a current interrupting means with two helpers. The helpers, relays which act as the brains of the outfit to indicate when there are excessive currents flowing through the circuit breaker, and the tripping mechanism which translates the thoughts of the brains or relays to initiate and complete the opening of the interrupting device. These two helpers may have other associates, that is, relays and closing mechanism which can close the interrupting means after opening to reestablish the circuit.

From this it follows that the fuse is a device which operates only when the current responsive element is destroyed by an excessive value of overcurrent regardless of direction of the overcurrent whereas the circuit breaker by means of its relays may operate within one range of current flowing in one direction through the breaker and an entirely different range of currents flowing in the opposite direction through the breaker. In the case of the fuse, service can be restored only by actual replacement of the current responsive means and possibly the interrupting means, but with the circuit breaker service may be restored at once or at any predetermined interval by the operation of relays or by an operator pressing a button. The fuse having a thermally responsive element with an inverse time melting characteristic operates more rapidly as the value of overcurrent increases. On the large values of short circuit current available at the lower voltages the current responsive element may fuse and the fault be cleared in one half cycle. In the newer types of current limiting power fuses the fuse operates so rapidly that the full first half cycle of fault current does not flow through the fuse but is effectively choked off to a small fraction of the short circuit current available. On the other hand a circuit breaker cannot interrupt a short circuit until its helpers give it a start. The brains or relays have been developed to have very fast operating times on high values of short circuit current but time is required to move the mechanical parts of the mechanism and to separate the contacts in the breaker. High voltage power circuit breakers have been developed with a total clearing time as low as 3 cycles but the average power circuit breaker has a total clearing time of 8 cycles at its interrupting rating.

Thus from a consideration of these elementary differences it can readily be seen that a fuse can be used as an overcurrent protective device under the following conditions: (1) When only one operation is required, that is opening the circuit on overcurrent when immediate restoration of service is not imperative since the protected apparatus must be serviced, repaired, or replaced as a result of the overcurrent or fault. (2) When the direction of flow of overcurrent is not a requirement of the protective device. (3) When the inherently faster operation of the fuse is required for the prevention of system outage or reduction of damage to the faulted apparatus.

Types of Fuses Available

To determine whether a fuse is applicable for a particular overcurrent protection problem, it is necessary to know what types and ratings are available for use. The manufacturers have a large selection of types to handle any job where a fuse is feasible from an engineering standpoint.

Starting at the generating station there are current limiting type fuses for all generating voltages with interrupting capacities ranging up to 1.5 million kva for the protection of potential transformers and auxiliary power circuits. For high voltage transmission circuits for operating voltages through 132 kv there are power fuses with interrupting ratings of one million kva first cycle symmetrical short circuit capacity, for protection of potential transformers and small power transformers. A parallel line of lower interrupting rating fuses is also available for the same voltages where the system short circuit capacity is approximately one-half million kva. For the sub-transmission voltages that is up to 69 kv there are fuses with interrupting capacities ranging from 100,000 kva to one million kva. For the distribution voltages 2400 volts to 33 kv there are numerous types of fuses for any range

of interrupting capacities up to a three quarters of a million kva.

There are three basic types of power fuses available. (1) The dry type expulsion fuse. This type includes the high interrupting capacity fuses for transmission voltages, high load current capacity fuses for distribution voltages as well as all light and medium interrupting capacity fuses for all voltage classes. (2) The liquid filled fuse for light and intermediate short circuit capacities for all voltage classes. (3) The current limiting type for light load currents for very high interrupting capacity for generating and distribution voltage classes.

In the application of fuses there are, in general, five major problems to be worked out.

(1) Interrupting capacity
(2) Current rating
(3) Voltage rating
(4) Permissible magnitude and duration of fault
(5) Mounting clearances and conditions

Interrupting Capacity

The manufacturers of power fuses express the interrupting capacity of these devices in R.M.S. asymmetrical amperes at rated voltage. This method of rating fuses results from the operating characteristics of fuses. On high values of short circuit current the fuse frequently melts and interrupts the fault in the first half cycle of the fault. A study of short circuit phenomena shows that when a fault occurs near voltage zero of the generated voltage wave on a system near the generator source where the system impedance is principally inductance, a displaced current wave with a large d-c component results. [1]The R.M.S. value of the first half cycle of such a current may reach a theoretical value of 1.73 times the R.M.S. value of a symmetrical short circuit at the same point. On actual systems where there is circuit resistance between the generator and point of fault the ratio is less and an average ratio of 1.6 is satisfactory for calculations of systems requiring high interrupting capacity fuses.

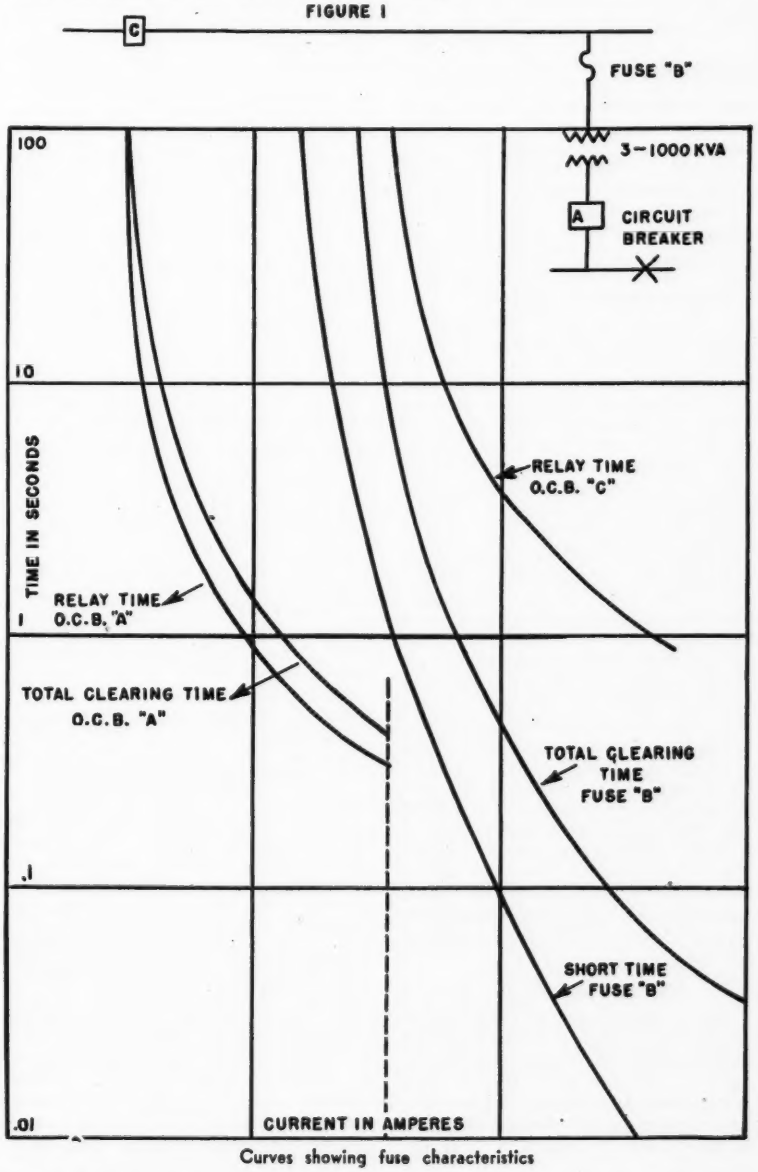
Since system short circuit analyses are based on instantaneous symmetrical, it is necessary to multiply the corresponding symmetrical current by a factor of 1.6 to determine the requisite fuse interrupting rating. Recently, the manufacturers have listed the interrupting capacity in both asymmetrical amperes and symmetrical kva; the latter taking the 1.6 factor into consideration and permitting direct comparisons with system short circuit values usually referred to.

It is very important to remember that in general fuses are not a constant kva interrupting device over a wide voltage range. That is for any one type of fuse the use of a fuse one or two voltage classes above operating voltage the interrupting capacity will not be the same as a fuse rating corresponding to the circuit voltage. This is especially true of expulsion and liquid type fuses. Current limiting fuses having voltage rating in excess of operating voltage should never be applied as will be discussed under the heading of voltage rating.

Current Rating

The selection of the proper current rating is the responsibility of the operating engineer, as the manufacturer is not in a position to make a blanket recommendation to use a certain fuse rating for a specific value of load current. This results from the numerous factors that must be considered in applying high voltage power fuses to obtain maximum system protection. The first factor to be considered is of course the maximum continuous load current. The continuous rating of the fuse should always be equal or greater than this value. The second factor is the possibility of short time peak overloads of emergency nature when it is essential that the fuse should not operate or be damaged. A third factor of particular importance is short time inrush current, as magnetizing or switching surges. All transformers when energized draw a very high current for several cycles following the closure of the circuit. The value of this surge is dependent on the point on generated voltage wave that the circuit is closed and on the residual magnetism of the transformer core. This value may be 150 times full load current in a potential transformer. In case of a power transformer, this surge may have an integrated value of ten times rated full load current for the first 6 cycles. Thus power fuses should have a minimum melting current of at least twelve times full load current at 6 cycles (0.1 second).

FIGURE 1



Curves showing fuse characteristics

[1]See "What Is This Asymmetrical Current and Why Do We Bother With It?" p 65, January 1944 issue (ED).

Another major factor particularly to be considered in applying the higher voltage power fuses is coordination with other protective devices. In any given circuit the operating times of the various protective devices increase progressively as the protective device is located closer to the source of power to obtain a definite sequence of operation of these devices. This is done to minimize power system disturbance and to maintain the maximum service continuity by isolating the fault as close to the location of the fault as is possible. To assist the operating engineer in the selection of the proper current rating of a fuse, the manufacturer of power fuses generally provides a set of three characteristic curves for each line of fuses. The first is the minimum melting time-current curves which are based on actual test data on actual fuse elements. Most selections of fuse ratings are based on this curve. The curve is supplemented by two other curves which are derived from the melting time curve. The short time or damaging curve shows the maximum value and duration of current that can pass through the fuse without damaging the fuse or its characteristics. This is of particular importance when in-rush currents and coordination with other protective devices on the load side of the fuse are being studied. The total clearing time curve which shows the maximum melting time plus arcing time is widely used in coordinating with other protective devices such as fuses and circuit breakers between the source of power and the ultimate load careful consideration must be given to the characteristics of each. The recommended procedure consists of plotting the time current characteristics of each device on a single sheet of log-log paper which is used for plotting fuse characteristics. See curves in the accompanying drawing. All current values starting with the curve of the device nearest the load are then plotted to a common scale, and then plotting the curves of the other devices progressing toward the source. For the general case of two devices in series, that is, transformer secondary circuit breaker protecting primary fuses from secondary faults the total clearing time of the circuit breaker must be less than the short time or damaging curve of the fuse. It is recommended that the margin between these curves be at least 10 per cent measured on the current scale to take care of the effects of variable ambient temperatures and the effect of preloading. Thus it is generally necessary to select fuses with much higher current ratings than would be required from the standpoint of load and in-rush currents.

Voltage Rating

Most power fuses are designed to interrupt all values of fault current up to the rated interrupting capacity at rated voltage and to withstand rated voltage after interruption. Therefore, the selection of the voltage rating of the fuse is merely dependent on selecting a fuse of the same voltage class as the operating voltage. But here again, there are a number of exceptions where it is advisable to use a fuse of a higher voltage class. For locations where excessive deposits of dust or other conducting particles collect on the insulating surfaces of the fuse or frequent salt fogs are prevalent, it is desirable to use a fuse and support of the next higher voltage rating. When fuses are used to connect two separate generating systems, a special problem is encountered. Since fuses are single pole devices, certain types of faults will not operate all fuses in a three phase system. In general, only two fuses will operate thus leaving the two systems connected through the remaining fuse. Under such conditions, it may be possible for the two systems to get out of phase and thus impose double voltage across the blown fuses. For such applications, fuses with a voltage rating double the normal operating voltage are recommended. Fuses on hydro generating systems frequently must have a voltage rating in excess of normal operating voltage. A short circuit on a waterwheel generator means that the actual kw load drops to a very low value and the kinetic energy of the water through the turbine increases the speed and hence internal voltage of the generator. The clearing of the fault imposes higher than normal voltage on the fuse.

The case of current limiting fuses deserves special attention. Current limiting power fuses function by producing a very high arc voltage immediately following melting of the fusible element. This arc voltage always exceeds the voltage rating of the fuse in order to effect current limitation and is virtually independent of circuit voltage. Therefore, current limiting fuse voltage ratings should coincide with the operating voltage of the system, otherwise objectionable voltage surges will be impressed on the system by the operation of the fuse, causing arrester breakdown or insulation flashover. Current limiting fuses of higher voltage rating should be used only if system and equipment insulation and arresters are of the same voltage class as the fuses.

Permissible Magnitude and Duration of Fault

Frequently it is desirable or even necessary to limit the amount of fault current which can flow to a piece of connected apparatus which is in trouble. The foremost examples are potential transformers and small auxiliary power transformers in generating stations or substations. The potential fault energy that could flow into a fault on such an equipment before conventional protective devices could operate, could readily create a disturbance of such magnitude to cause a partial shutdown. For such application a current limiting fuse is preferred to the exclusion of any other type of protective device, since such fuses in the current ratings involved limit the peak fault current to a few hundred amperes even on a million and a half kva short circuit capacity bus. Another example which is of particular importance in large industrial electrical distribution systems is the protection of high voltage motor starters. Here current limiting fuses in addition to greatly reducing arc damage at the point of fault reduce the mechanical stresses incident to high short circuit currents so that inexpensive contactor type motor starters can be used and distortion of motor windings by magnetic forces is virtually eliminated.

Mounting Clearances and Conditions

The selection of the type of fuse to be used on a specific application is dependent upon the physical location of the fuses and the clearances available. For all indoor applications, where available space is at a premium and other electrical circuits or equipment are in close proximity, the fuses should be totally enclosed so that no flame or conducting gases are expelled when the fuse operates. This rules out the conventional expulsion or liquid type of fuses. Boric acid dry type fuses equipped with condensing devices to make them totally enclosed are satisfactory as are current limiting type of fuses being especially designed for this type of service. Disconnecting types of fuses are generally preferred as removal and replacement of the fuse unit is simplified. Also, the disconnecting feature eliminates the need for separate disconnecting switches to isolate the connected equipment from the system during periods of idleness, inspection, maintenance and repair. If the fuses are to be disconnected from a "live" circuit, it is imperative that suitable interlocks or provision be made to prevent opening the fuses while carrying load current. If charging current of bus or cable or magnetizing current of potential or small operating transformer must be opened, suitable insulating barriers must be provided between phases and between phases to grounded structure. In outdoor substations no special mounting precautions are required as normal phase spacing for conductors or disconnecting switches are adequate for most fuses. It is, however, necessary to locate the fuses so that discharge of gases or conducting parts from expulsion or liquid types of fuses are not directed toward other energized equipment or personnel. Disconnecting fuses are in the same category as a hookstick operated disconnect switch and have no interrupting capacity when operated as a disconnect except for magnetizing current of small transformers, hence, provision must be made to prevent opening fuses while carrying load. In the case of high voltage high interrupting capacity fuses, it is almost imperative that a gang operated remote controlled disconnect switch be used to isolate the fuses before handling them.

POWER-TRAINS

As indicated on Page 68 of this issue, both Westinghouse and General Electric are building mobile power plants in the form of trains for use in the war devastated regions of Europe. Details of the types of units built by the respective companies are presented here. The General Electric 3000-kw plants use fire-tube locomotive type boilers while the 5000-kw Westinghouse trains use water tube boilers built by Combustion Engineering Co.

Westinghouse Power-Trains*

By C. M. LAFFOON
Manager, A. C. Generator Engineering
Westinghouse Electric & Mfg. Co.

AT THE PRESENT stage of the war, there is a pressing and growing need by the United Nations (U. S. and Allies) for mobile electric power generating plants in war zone areas where there has been widespread devastation and destruction of materials and property which are vital to the existence of the inhabitants. In these countries where the electric power plants have been destroyed or put out of commission, a certain amount of power is required by the occupying Army or Navy over and above their normal power supply needed for primary military operations, to operate base hospitals, machine shops, repair shops, and replacement parts manufacturing plants. Likewise, a similar minimum amout of electric power is required by the civilian population to operate hospitals, re-establish and operate water supply and sewage systems, operate repair shops and manufacturing plants for machine tools, and carry on other projects which are vital to the beginning of a rehabilitation program, to enable the civilian population to become self-sustaining and to effectively coordinate and cooperate with the military program. It is felt by some authorities that the total amount of mobile power plant capacity required for a particular area should be on the order of 2 to 3 per cent of the generating capacity existing in the area previous to the devastation. The present electric power needs of the particular countries in question are being taken care of in a large measure by using relatively small steam and Diesel driven generating plants which can be readily transported and easily installed in the vital areas. In some instances steam-driven power plants assembled for operation on conventional land and water transportation means have been built. It is expected that the need for mobile generating plants will increase in Central and Western Europe and Asia as the war progresses. The type of generating plant required and eventually selected for these areas will depend on the conditions under which the plants must be transported and operated.

The Westinghouse Electric & Mfg. Co. is now building for our Allies 24—1000 kw and 10—5000 kw portable, self-contained steam electric power plants. These power plants are assembled in specially designed railway cars which, with suitable trucks, can be transported over most American and some foreign railroads, and can be operated to generate electric power when located on satisfactory railway sidings and provided with necessary supplementary foundation supports. This type of portable generating plant has been called the POWER-TRAIN by Westinghouse.

It is obvious under the present war emergency conditions that the primary objective in designing and building generating plants of this type is to obtain the maximum output per unit of materials, comply with the purchaser's specification requirements, and meet actual operating conditions. The design is further restricted by the following assembly and transportation limitations, and operation requirements:

1. The height and width clearance limitations of the railroads over which the POWER-TRAINS are to be transported.

*Abstract of an address at the meeting of the American Society of Mechanical Engineers, Pittsburgh, Pa.

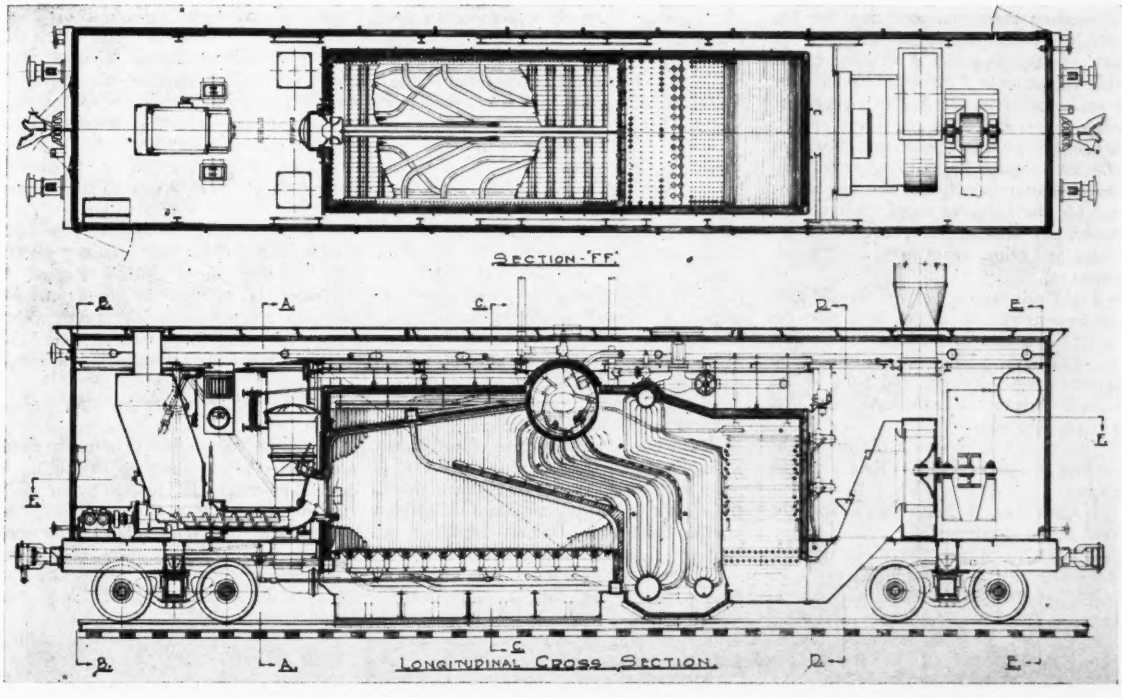


Fig. 1. Details of the boiler car used with the 5000-kw Westinghouse trains. The equipment consists of a Combustion Engineering Co. water tube boiler, a Standard locomotive-type spreader stoker, a Hulson-type locomotive grate, a fully water cooled furnace, and a locomotive-type combustion arch

2. The weight limitation per axle of the trucks and the total car weight limitation on the rails.

3. Full output rating is to be produced when using low grade lignite fuel with approximately 7300 Btu, 22 per cent ash, and 24 per cent moisture.

4. The plants are to be capable of being placed in operation without the use of an external source of power supply.

5. The full rated output of the generating plant is to be obtained over an ambient temperature range of —40F to +95F.

6. A limited amount of water is available for make-up and cooling purposes.

5000-kw Power-Train

While the design of a conventional 5000-kw steam turbine driven power plant for normal conditions does not usually offer any serious difficulties many problems are introduced when the plant is required to be assembled on railway cars which can be transported over railroads. In meeting these conditions, with the present limitations in the use of critical materials, it has been necessary to make readjustments in power plant design standards and make rational compromises in many instances in order to obtain the desired result. It was necessary at all times to keep in mind two elementary criteria in designing the generating plant—namely; (1) will it work and is it reliable; and (2) is it simple to operate and maintain.

The specification requirement that the power plant operate with a minimum loss of water made it necessary to use a closed steam cycle and air cooled condensers. Space and weight limitations, and reliability were important factors in determining the steam conditions for the 5000 kw, 3000 rpm prime mover to be 600 psi gage and 750 F at the throttle, and exhausting at 2 psi gage. Under these steam conditions the turbine generator will require 80,000 lb of steam per hr to produce a gross generator output of 5000 kw. Space limitations, steam production requirements, and the low grade fuel for the furnaces fixed the type and number of boilers, superheaters, economizers and other steam generating auxiliaries.

Eight railway cars of the freight type and approximately 50 ft long are required to house and support the main and auxiliary power plant equipment. The cars were designed and built by the General American Transportation Corp. at East Chicago.

The designation and arrangement of the cars in the POWER-TRAIN are as follows:

1. Cars No. 1 and No. 2 for the main steam condenser.
2. Car No. 3 for the main turbine-generator unit and switchboard.
3. Car No. 4 for the air compressors and the boiler feedwater pump.
4. Car No. 5 for the boiler feedwater.
5. Cars No. 6 and No. 7 for the main steam generating equipment.
6. Car No. 8 for work shop and living quarters for the operating crew.

Each POWER-TRAIN will be supplied with the essential coal and ash handling equipment required to operate the power plant.

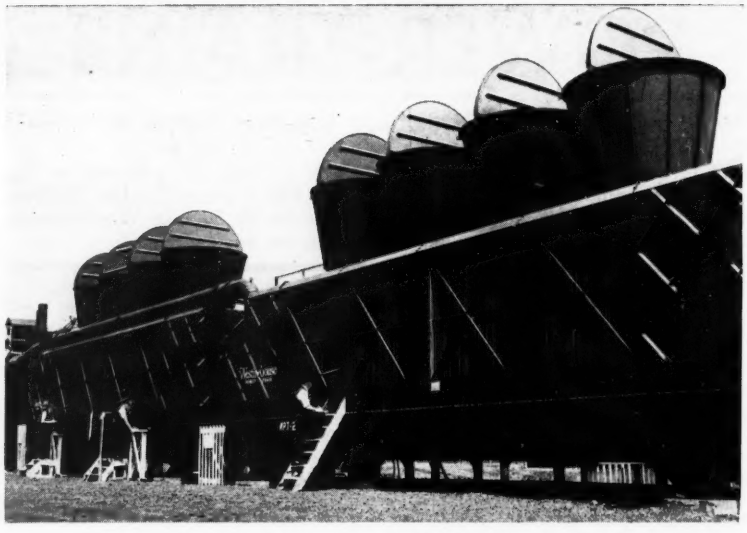


Fig. 2. The air condenser cars of the Westinghouse Power-Train

Air Cooled Condensers. The main steam condensers are novel in that air is used as the cooling medium since no cooling water was permitted for this purpose by a contract requirement. This condenser is designed to condense the exhaust from the 5000 kw turbine at a maximum back pressure of 2 psi gage, when cooled by air at temperatures from —40 F to 95 F. The prime function of the condenser is the recovery of condensate.

In this air cooled condenser it is imperative that steam be supplied to all the cooling surface; otherwise under extremely low ambient conditions ice will form on the idle areas leading to blocked and eventually ruptured tubes. The flow of air through the condenser sections is controllable.

Eight condensing sections are installed on each of two cars. Four blowers on each car draw the air from the outside through the condenser to a plenum chamber at the center and then discharge it upward. Each air discharge stack is provided with a hinged cover which is normally opened when its respective blower is in operation and can be closed when its blower is not in operation. This is to prevent recirculation when blowers are removed from service on account of low ambient temperature conditions.

Each condenser car is equipped with a single stage ejector and an air cooled after condenser. The chief function of the ejector is to keep air from collecting in the condenser sections, resulting in cold spots and possible ice formation.

Turbine Generator Car. The turbine generator car contains the main turbine generator unit, an auxiliary Diesel generator unit, a service transformer, and switchgear equipment.

The main turbine is rated at 5000 kw and is designed for using steam at the throttle of 600 psi, 750 F, and exhaust at 2 psi. The generator delivers power at 6300/10,900 v, 50 cycles, 0.8 pf, 3000 rpm, and 6250 kva. The generator is equipped with air filters to aid in maintaining cleanliness of the machine.

Power for the train auxiliaries is furnished by the 750-kva air cooled transformer at 380/220 v, 3 phase, 50 cycle, 4 wire. The transformer is connected to the 5000 kw generator through fuses and is provided with low voltage breaker assembly for motor and lighting service.

For use in starting up the POWER-TRAIN, a 93.8 kva, 75 kw, 380/220 v, 4 wire, 50 cycle Diesel engine driven generator set is provided.

The totally enclosed metal-clad switchgear contains oil circuit breakers for control of the main generator, the four high voltage feeder circuits, and high voltage fuses for the TRAIN service transformer.

Auxiliaries. Car No. 4 contains the following auxiliaries:

1. Two 3600 rpm boiler feedwater pumps driven by Westinghouse steam turbines.
2. One evaporator unit of sufficient capacity to provide the required make-up of 2400 lb per hr of 32 F water. A deaerator to remove the air from the make-up, and a small motor driven water pump for delivering treated water to the evaporator are included in the evaporator unit.
3. One set of water treating equipment.
4. Three 400 cu ft per min air compressors—one of which is driven by a direct-connected 100 hp, 50 cycle, 720 rpm induction motor and the other two are driven by Westinghouse turbines through speed reducing gears. The compressors will supply air to operate the boiler stokers, coal spreaders, and soot blowers.
5. Air storage tank, water cooling tower and pump.

Boiler Feedwater. The boiler feedwater car which is thermally insulated, and provided with heating coils, has a feedwater storage capacity of 10,000

gal. Each feedwater car has two motor-driven 225 gpm booster pumps which deliver feedwater to the supply line of the boiler feedwater pumps.

BOILERS. The two boiler car units are essentially duplicates and are arranged so that the stoker ends are adjacent to each other. Each boiler car contains:

1. A 40,000 lb per hr, two drum, bent tube, water wall boiler designed for 660 psi gage, 750 F total temperature with the feedwater entering the economizer at 200 F. The boilers were designed and built by, and all steam generating assembled on the boiler cars by the Combustion Engineering Co.

2. Superheater and economizer.

3. Soot blowers and a locomotive type stoker. These devices are air operated in order to minimize the amount of make-up water.

4. Two 9900 cfm motor-driven forced draft fans and one two-speed, 46,000 cfm motor-driven induced draft fan.

5. Necessary measuring instruments and control equipment.

SERVICE CAR. The service car provides living quarters for the operating crew of the POWER-TRAIN, and space for light repair work.

The 3000 kw G. E. Mobile Plants

BY USE OF MOBILE electric power plants installed in standard railroad cars, damaged tanks, trucks and other important war equipment can be repaired close behind the fighting lines, thereby saving valuable hours, often days in Russia's drive into the Nazi occupied countries. So declared Lieut. General L. G. Rudenko, chairman of the Soviet Government Purchasing Commission, after inspection and acceptance of one of the first such portable plants built by General Electric and the American Car and Foundry Companies at the A.C.F. plant in Berwick, Pa.

Gen. Rudenko, veteran of the bitter fighting in the defense of Stalingrad who has been in this country but four months, said that the Soviet armies were often seriously handicapped when damaged equipment had to be moved several miles back of the lines to the nearest repair shop.

Forty of these portable power stations are under construction. Each is contained in a train of 10 railroad cars and capable of furnishing 3000 kw of electricity within a few hours after arrival at any designated area. In addition to the wartime use of keeping the repair shops operating close behind the advancing troops, these mobile plants will also prove most helpful in rehabilitation of Russian cities and villages laid waste by the retreating Nazis. According to Gen. Rudenko the Germans never failed to blow up the power plants in any city they evacuated, which crippled the water supply, the operation of hospitals, sanitation systems, and left the cities in complete darkness.

It takes weeks, sometimes months, to rebuild power stations. If the railroads have not been destroyed by means of these mobile units power can be had within 24 hr. And if they have, new rails can be laid in short time.

The Russian units are not the first mobile power plants that have been built since the war began. The first to be completed were of 10,000 kw size, built by the General Electric Co. for the United States Navy, which were originally intended as a wartime emergency measure to bring power quickly to a locality suddenly deprived of its usual supply. Two of these plants have been operating successfully in this country for several months by the Navy.

A logical sequence was the development of similar but smaller plants for use in war-torn Europe.

The keynote of these new plants had to be simplicity and the utilization of equipment easy to operate and maintain according to A. R. Smith, General Electric engineer in charge of the company's Construction Engineering division. This has been accomplished and there's nothing fantastic or grotesque in the design of these trains. Tests have proven the simplicity of operation, the speed with which the power train may be put into service and electric power made available.

These 3000-kw mobile plants consist of two boilers cars and tenders, one turbine car, one switchgear car, three cooling tower cars, and one crew car.

The two boiler cars per power plant contain a fire-tube locomotive-type boiler designed to operate at 300 psi, 600 F. The boilers are coal-burning, employing poor grades of coal such as lignites with heat values of less than 7000 Btu per lb. Each boiler is rated 24,000 lb of steam per hr. An adequate supply of coal and makeup water were carried on the tender car which is similar to that used on standard locomotives.

Coal is handled by means of portable conveyors which can take it either from a pile or a coal car and put it in the tender from which it is fed automatically to the boilers. Ashes are removed by a simple electrically-operated portable unloader at track level.

The turbine car contains a 3000-kw turbine-generator arranged to deliver power at either 6300 or 11,000 v. The condenser is of the surface type, located on the same elevation as the turbine generator. The switchgear car contains the main switch gear which is of the metal-clad type and houses the indicating and control apparatus for the main generator. Two feeder circuits are brought out through each side of the car near the top for connection to outside power lines.

The three cooling tower cars contain wood cooling surface arranged in two cells. The wooden structure is mounted on a steel water basin on the car platform. The cooling air is supplied by four fans located in the top of the car and driven by direct-connected vertical motors. A vertical circulating pump directly connected to a motor is located on each car for pumping water through the condenser.

The crew car contains living and sleeping accommodations for the operators. A portion of the car is used as a maintenance room and test laboratory.

These mobile power plants on their own wheels are hauled by railroads to the site, spotted on a single track and require only the connection of steam pipes, water pipes and electric cables, all carried on the cars, to be ready for operation. The plant can be put into operation in eight hours time or less. The disassembly can be much faster, if required.

To provide for desert operation, or where water is available only in limited quantities, the three cooling towers on several plants are replaced by two radiator cars. These do not use any water, so that water is required only for the boiler make-up which is two or three per cent, depending on the character of the water supply.

Fig. 3. A view of the 3000-kw General Electric mobile power plant

Treating Process Water *for* Wright Aeronautical

Part I

Water requirements for the Wright Aeronautical Corp. plant near Cincinnati, Ohio, equivalent to those of a city with a population of 200,000 . . . About 25 per cent of this water is needed for domestic consumption and sanitary purposes . . . Remaining 75 per cent, for industrial purposes . . . The treating plant is one of the largest and most modern in the World . . . This article describes water uses, objectives in treatment and water softening plant design . . . System used is cold process lime-soda . . . A second article will describe the filtration system and methods of control used

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WATER is a very essential industrial commodity, the importance of which has been increasingly recognized by industrial operators and especially by the aircraft manufacturing industry.

For the Cincinnati Plant of the Wright Aeronautical Corp., one of the largest aircraft engine plants in the country, the water requirements are equivalent to those of a city with a population of 200,000. Not only must the water be equivalent to city water in chemical and bacteriological purity, it must also be superior in many ways to be fit for the processes in which it is employed.

Careful and detailed consideration therefore must be given to all the industrial uses in such a plant so that the quality of the water required may be intelligently specified.

Water in its natural state usually contains a number of impurities many of which are undesirable for industrial use, domestic use, or both. In this plant, large volumes of cold water are required for heat exchange, because the air for the carburetors, engine testing and gasoline need to be cooled below 75 F. to meet Army specifications. This necessarily requires water at a temperature of 60 F or lower which is available only from the underground supply.

Initial water requirements for this plant were estimated to be approximately 5000 gpm and a water treating plant with a capacity of 5500 gpm was therefore installed (Fig. 1) to take water from six 1000 gpm deep wells located on the property. Water from different wells was found to vary from 300 ppm to 900 ppm in hardness, with an iron content varying from 1.5 to 5.0 ppm. Approximately 180 to 300 ppm of magnesium hardness is present on these various well waters, with

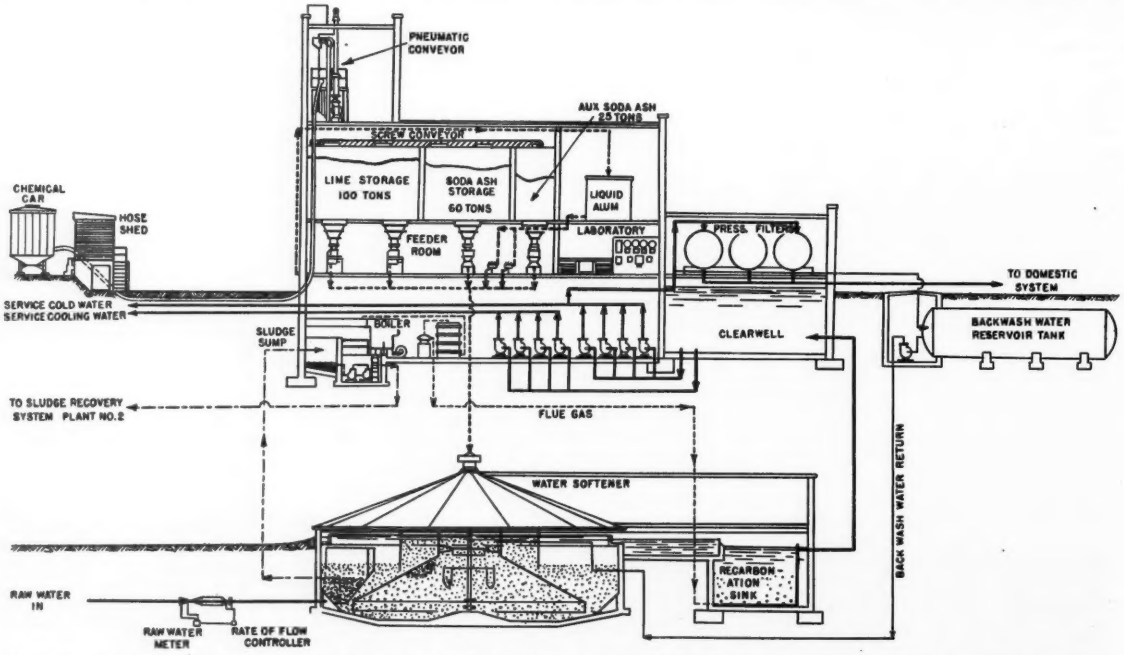

Fig. 1. Diagram of the first water treating plant installed. This plant was designed for a capacity of 5500 gpm—approximately 8,000,000 gal a day

the remainder calcium hardness. It is most unusual to find a large variation in the hardness that was found on these several wells, all located on the same property and this variation in hardness was found to continue between these several wells with continued use and pumping.

Before the first treatment plant was completed, the engine schedule was revised and it was decided to greatly expand the facilities. As a result, a second water treating plant (Fig. 2) was installed to handle approximately 9500 gpm. In the short space of a year, two large water softeners were placed in service. The second water softener was designed to handle the same type of well water as the first softener. However, due to an anticipated failure of the water table in the Millcreek Valley, a new water project was undertaken by the Federal Government to meet the requirements of the plant. Water from this second source has a hardness considerably below that of the original well water from the property, averaging approximately 300 to 350 ppm total, with a low iron content. Early experience with the operation of the first plant presented some unusual treatment problems due to the variations of the hardness of the several deep well waters. The difference in the characteristics of the water from the new project from the well water obtained on the plant site also presented a few problems.

Of the total requirements of the plant, however, it was estimated approximately 25 per cent would be required for domestic consumption and sanitary purposes and the remaining 75 per cent for industrial purposes. As original requirements were based on a cold water at approximately 58 F, the use of well water throughout the plant was deemed the most practical and only solution.

Water Use

In addition to general plant requirements, sanitary requirements, etc., water is needed in process for pickling, heat treat, plating, dynamometer, engine testing, paint and baffle shop, gasoline system, air and gas coolers, anodize and dichromate, oil and chip house, boiler house, rotoclones, X-ray developing baths and miscellaneous heat exchangers throughout the plant. Many uses for the water are critical and it was imperative that a deposition of solids in many points of heat exchange be prevented, and that the solids in the water would not interfere in the various chemical processes and plating baths. Since a large percentage of the water usage was considered to be of a critical nature, in addition to that required for domestic consumption, it was decided to treat and soften all the water.

The objective of water treatment at this plant may be summarized as follows:

1. Minimize corrosion.
2. Reduce calcium hardness to prevent calcium carbonate scale.
3. Reduce iron content.
4. Provide a stable water, neither scale forming nor corrosive.
5. Provide a sterile water, satisfactory for drinking purposes and eliminate the necessity for complicated piping system that would be required for treating only part of the total water needed.

1. Minimize Corrosion

The well water as received contains appreciable quantities of free carbon dioxide. This, together with any dissolved oxygen picked up in contact with air after the water leaves the well, could result in considerable corrosion. It is desired that dissolved oxygen be held at a minimum and that the pH value be maintained at that point where calcium carbonate will not deposit nor will there be any tendency to corrosion due to a low pH value.

2. Reduction of Calcium Hardness

A hardness of 50 ppm in water is considered low, and such a water a soft water; a water with 125 ppm a medium hard water, and a water with 200 ppm and over a very hard water. It is immediately apparent that water with hardness from 350 to 900 ppm is extremely hard water and is likely to cause considerable difficulty if not properly treated. Both calcium and magnesium contribute to the hardness.

As long as the pH value is maintained below 9.0, however, it is only important that the calcium hardness be reduced as there will be no tendency for magnesium to leave solution in the form of deposits with water at this pH. With the hard water, and with a calcium and alkalinity content such as is present in the raw water supply, the calcium will leave solution and deposit scale in the plant distribution system and in heat exchangers where temperature rise is encountered, even though that rise be slight. The scale so formed will be insoluble calcium carbonate.

The possible use of sodium hexametaphosphate was considered as an inhibitor and the idea was discarded as it was felt that insufficient protection would result because of the high hardness and the relatively high temperature differential encountered. It was therefore decided to treat this water and control for calcium hardness softening only, without softening to reduce the magnesium hardness. This can be done in a cold process lime-soda softening system, controlling the pH value at approximately 9.6 to 9.8. A considerable economy is effected in chemical costs, reducing calcium harness only and allowing the magnesium hardness to remain in the soluble form as following the softening action the pH value is reduced to 8.6, a point at which no magnesium may be expected to leave solution at any point in the process or distribution system.

3. Reduce Iron Content

It is desirable to reduce the iron in the water to a minimum, because it is known from experience that iron in excess of 0.3 ppm will stain sanitary fixtures, cause iron deposits to form in piping and distribution systems and interfere with operations in such areas as plating, X-ray laboratory and special processes. The lime-soda system of softening water with a pH value maintained

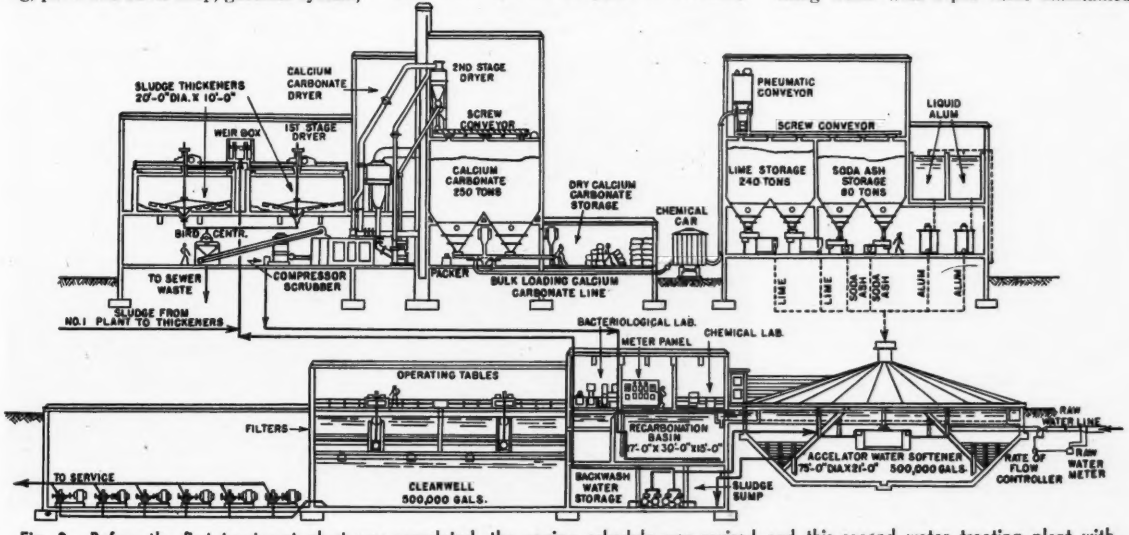

Fig. 2. Before the first treatment plant was completed, the engine schedule was revised and this second water treating plant with a total capacity of 14,000,000 gal a day, installed

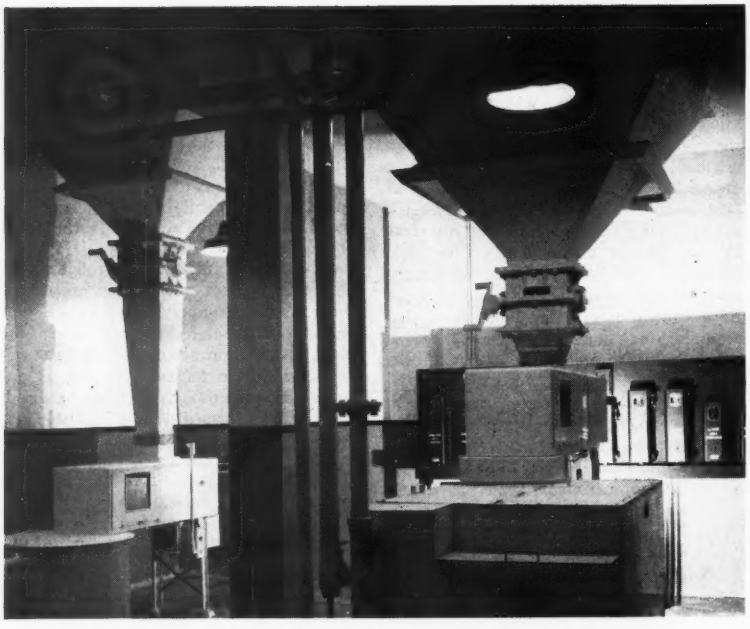

Fig. 3. Lime feeders in water softener plant No. 2

at 9.6 or higher will effectively precipitate the iron and deliver a water with an iron content of not more than 0.05 to 0.1 ppm.

4. Provide a Stable Water

With due consideration to the above factors, following reduction of the calcium hardness and precipitation of the iron, the pH value of the water must be lowered to the point where the water is quite stable to eliminate any tendency for further deposit of calcium carbonate or any tendency for the water to re-dissolve any calcium carbonate that might be present in itself in the piping or distribution system; or, in other words, to deliver a stable water to the system. The stability of the water can be determined from analysis and from an application of the Langelier Formula, with a knowledge of the calcium hardness, total dissolved solids, temperature, alkalinity and pH value.

5. Provide a Sterile Water and Eliminate Complicated Piping System

By treatment of all the water to deliver a water fit for domestic consumption, the need for complicated piping systems and the attendant danger of cross connections is eliminated. A number of the processes are so distributed over the plant that it would be practically impossible to treat a portion of the water and allow the remainder to be circulated separately without a great deal of additional piping and complications, so that it was definitely worthwhile to design for a single standard of water quality; namely, a water that could be used for drinking and domestic purposes as well as for the industrial process.

Water Softening Plant Design

Treatment Plant

The raw water is treated in a continuous cold process lime-soda softener using a vertical flow and a sludge slurry pool and flows through the softener through a recarbonation tank where carbon dioxide is added from a scrubbed flue gas to maintain a stable water. From this tank the water passes through gravity filters to a clear well from which it is pumped to the distribution system. Two elevated storage tanks with a combined capacity of 750,000 gal float on this system and of this amount, 150,000 gal are held in storage for sprinkler service and the remainder is available for service and domestic water.

Chemical Handling

Lime and soda ash are received in bulk by truckload or rail car and unloaded pneumatically directly to concrete storage bins located over the chemical feeders to permit gravity feed from the storage to th feeders to the softening tank. Storage is provided in one plant for 100 tons of lime and 50 tons of soda ash and in the large plant for 240 tons of lime and 80 tons of soda ash. Alum is used as a coagulant and is received from the manufacturer in a liquid form in tank trucks; is pumped to an elevated rubber lined storage tank from where it flows by gravity to decanting feeding tanks and thence to the softener.

Chemical Feeding Devices

Duplicate chemical feeders have been furnished for each chemical. Feeders for the lime and soda ash are of the gravimetric type (Fig. 3), designed to feed chemicals by weight and to feed at a rate proportional to the flow of water to the softening basin so that the feed at all times is directly constant to the quantity of water to be treated and may be changed by the operator to meet changed chemical conditions or changed chemical demand. The lime is live lime and feeds through a continuous mechanical slaker. Soda ash feeds to a small mixing tank and from the slaker and mixing tanks the solutions are piped directly to the interior of the softening basin. The liquid alum from the decanting feeder is also piped directly to the softener basin (Figs. 1 and 2).

A decanting type of solution feeder is provided for the feed of hypochlorite to the water flowing to the recarbonation basin from the softener.

Softening Basin

Each softening basin is of the Infilco design and known as an Accelator. The small basin in No. 1 plant is 60 ft diameter (Fig. 3) and holds approximately 350,000 gal; the large basin in No. 2 plant (Fig. 2) is 75 ft diameter and holds approximately 500,000 gal. Each basin has a retention time of one hour at maximum flow.

In the accelator basin, about 30 per cent of the space is devoted to mixing and reaction and the remainder for clarification. The incoming raw water and the chemicals are constantly mixed with recirculating, previously precipitated

Fig. 4. Valves which control the CO_2 mixture and manufacture in the Wright Aeronautical Water Softening Plant

sludge to accelerate the softening reaction. The softened and clarified water separates from the slurry pool and rises vertically in the outer section of the basin and overflows a weir, located around the outer circumference of the basin, into a circumferential trough and thence through a concrete flume to the recarbonation basin.

A portion of the precipitated sludge resulting from the softening process is allowed to continuously settle in three sludge concentration pockets from which it is automatically discharged, at regular intervals, by gravity, to a sludge sump in the main building and pumped to the sludge processing system described later. Sludge can also be withdrawn manually from the floor of the softening basin through a quick opening valve.

The raw water entering the accelator basin is piped from a reservoir and from the wells through wood stave pipe. An orifice in the raw water line (Fig. 2) at the water softening plant produces a differential to actuate the raw water meter and also the chemical proportioner to effect a proportional feed of chemicals to the softener.

The softened and clarified water leaving the softener basin has an average turbidity of 2.5 to 4.0 ppm. This residual turbidity is removed in the filters.

RECARBONATION

Water from the accelator softening basin has a pH value of approximately 9.6 and is supersaturated with calcium carbonate. This pH value is lowered in the recarbonation basin to an average of 8.6, a pH value calculated to give a stable water for use in the distribution system.

The accelator softened water is distributed in an inlet trough across the recarbonation basin in such a manner as to prevent short circuiting of flow at the inlet. The water remains in this basin for a minimum period of five to six minutes at maximum flow rates. Flue gas from an oil burning furnace passes through a heat exchanger to cool the temperature of the gas from furnace temperature to approximately 600 to 700 F. Water from this heat exchanger is used in heating domestic and hot water required for the plant. From this point, the gas passes through a scrubber which consists of a limestone bed with water sprays (Fig. 4), then passes the control valve that regulates the quantity of gas to the recarbonation basin, is compressed by a compressor and distributed in the recarbonation basin through a grid of piping in the bottom of the basin. The quantity of flue gas is automatically regulated and proportioned to the raw water flowing to the accelator basin and is further regulated by the pH value of the water leaving the recarbonation basin. The recarbonation basin is vented to the atmosphere. The pH value of this water delivered from the recarbonation basin is continuously recorded and the controller operating from this recorder acts to establish the ratio of flue gas to water flow. If the alkalinity of the water from the softener increases, the pH control equipment will act to increase the flow of gas per unit flow of water to the softening basin. It will also act to increase the flow of gas if the CO_2 content of the gas decreases, as in such an event additional gas will be required to effect the same reduction of alkalinity. This automatic control eliminates the necessity for manual adjustment and tends to hold the pH value at the desired point to maintain a stable water.

(This is the first of two articles on this water treating system by the authors. A second article describing the filtration system and control system will appear in a subsequent issue.)

ASRE Discusses Problems New and Old at Annual Meeting

New light shed on existing problems by the work done on new problems that have arisen during the war. Refrigerating engineers have had a major part in solving these problems, as discussed at the ASRE Spring Meeting in Pittsburgh, June 5 to 7

WITH A TOTAL registration of 477 members and guests, the Spring Meeting of the American Society of Refrigerating Engineers was held at the William Penn Hotel, Pittsburgh, Pa., from June 5 to 7. Four technical sessions were held and an interesting program of special features gave the members pleasant memories. A solemn note was introduced into the meeting on the morning of June 6 when news of the European Invasion was received, reminding the members how much of their work has been devoted to bringing about this very object. Special news broadcasts of the invasion were presented before the convention and it dominated the last two days of the sessions.

The first paper to be presented, very appropriately, was a detailed survey of the entire field of refrigerants and absorbents. In his paper under this title, W. R. Hainsworth, vice-president, Servel, Inc., reviewed the early refrigerants, such as ether, SO_2, CO_2, ammonia, and the like. Development of refrigerants such as dichlorethylene and methylene chloride, for use in air conditioning, were discussed.

The new Freon series of refrigerants, now so widely used, were first described in detail in 1930. They resulted from a somewhat casual suggestion by C. F. Kettering to Thomas Midgley. After discussing these Freon refrigerants, the author took up organic solutions and finally, the characteristics of absorbents, particularly the research of Servel in the field.

Data on amine compounds with water as the refrigerant were tabulated and discussed and an appendix to the paper gives a table of refrigerants and absorbents.

Psychrometry in the Frost Zone, by D. D. Wile, Carrier Corp., presented many new ideas about the use of the wet bulb psychrometer in humidity measurements in comfort air conditioning. Discussing the ice-coated bulb, the author pointed out that the wick covering for the wet bulb thermometer at temperatures below freezing no longer serves its usual purpose, for ice, unlike water, does not respond to capillary forces. True wet bulb readings are obtained only when the surface of the wick is completely covered with a layer of ice. Ice held within the wick is useless.

The author discussed the factors of super-cooled water, radiation from the observer, effect of air stream velocity and other factors and presented a new psychrometric chart with several features especially applicable when working in the frost zone.

This paper was discussed thoroughly by members, who brought out the method of using thermocouples for humidity measurements and the use of the mirror surface for determining the dew point.

Efficient Use of Insulation was the subject of L. E. Cover, Manager, Equipment Insulation Department, Armstrong Cork Co. He discussed not only domestic refrigerators but also factors in freezer room construction, details of inspection of cold storage, zero degree freezer rooms, effect of breather vents and the like. His conclusion was that as a result of available evidence, in construction of factory manufactured food-handling equipment and cold storage rooms built on the job, the major consideration for efficient performance of the insulation is as nearly a perfect seal as possible on the warm side of the room to prevent the original accumulation of moisture in the insulation.

In his paper on The Post-War Domestic Refrigerator, Arthur W. Ewell, Worcester Polytechnic Institute, reported research work from which he was prompted to make two recommendations for such refrigerators.

1. A temperature of about 37 F should be maintained within a few degrees uniform throughout the cabinet and constant during a cycle.

2. A high relative humidity should be maintained, i.e., 85 to 95 per cent.

Tests on growth of bacteria, effects on color of food, odor and cross con-

(*Continued on page* 132)

The Design and Maintenance of
I. D. FAN INSTALLATIONS

By PAUL R. DUFFEY

Special Engineer
The Youngstown Sheet & Tube Company
Youngstown, Ohio

THE SUBJECT of induced draft fans is one of intriguing interest to engineers, generally, and one which offers possibilities for continued study and development, not alone from the standpoint of efficient design but from the standpoint of maintenance and operation as well. While the designers of such fans are capable of designing highly efficient units, they often have to do their work with little, if any, real help from the usual prospective customer. My purpose in writing this article is primarily to stress the important fact that the installation of a given induced draft fan is a problem for the prospective owner's engineers. I believe that I am fair in stating that approximately one-third of the induced draft fan installations are more or less of a mess and not worthy of the specific knowledge and information available on the subject.

Design of Duct Work Very Important

Improper duct work leading to an induced draft fan and from it, restricted gas passage through economizers, air heaters, etc., not only reduces available fan capacity, but increases erosion on the fan wheel, as well as certain of the duct work. A sharp entrance to the fan say through a long turn 90 deg elbow is equivalent to about two-thirds of a cyclone and certainly stratifies the dust laden gases and/or ash into jets instead of keeping it uniformly suspended.

Extensive research by fan designers and manufacturers in collaboration with users of their equipment has proved without a doubt that single and/or double effect elbows cuts fan capacity as much as 20 per cent. On some installations stationary and sometimes adjustable inlet vanes have been installed in the duct work with splendid results in directing gas travel into the fan as it should be. Proper vaning of inlet ducts has improved fan capacity and made no appreciable increase in the power required to drive the fan.

As for example we will take two identical boiler units and identical fans, duct connections to one boiler as shown in Fig. 1, no vanes installed in the duct work. In Fig. 2 the fan has been installed in such a manner that it is directly above the air heater and inlet duct work is free of bends. Directional vanes installed. Both fans have steam turbine drives capable of developing 100 per cent excess power, and at such speed that identical ratings can definitely be established on each boiler unit. The first installation, Fig. 1, requires 20 per cent to 40 per cent more power than the second installation, Fig. 2. The fan wheel in Fig. 1 installation requires replacing in 50 per cent to 65 per cent of the time required on the installation in Fig. 2. These are cold facts based on 17 yr actual experience. Eventual vaning of the inlet ducts to Fig. 1 installation reduced power consumption about 10 per cent and wheel replacement period was extended about 15 per cent.

The foregoing paragraphs give a general idea of the importance attached to the purchase of an induced draft fan installation. It can be either good or bad.

Fuels burned are also another very important item in so far as induced draft fans are concerned. In continuing this paper the writer has in mind firing with:

1. Pulverized coal alone
2. Pulverized coal in combination with so called dirty, dry, cold blast furnace gas (89 to 95 Btu)
3. Pulverized coal in combination with so called dirty, saturated, hot blast furnace gas
4. Hot, dry, dirty, blast furnace gas (83 to 90 Btu)
5. Bunker C fuel oil, alone and in various combination with blast furnace gas

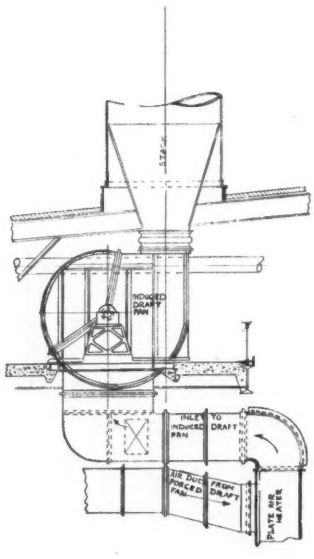

Fig. 1. Induced draft fan installed with no vanes in the duct work

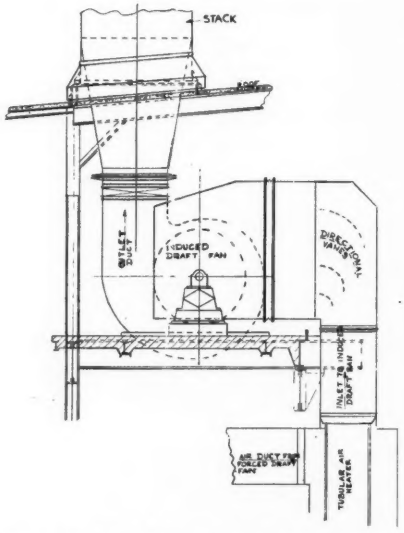

Fig. 2. This fan is identical with that shown in Fig. 1 but it is placed directly above the air heater and the inlet duct is free from bends. Directional vanes are also installed

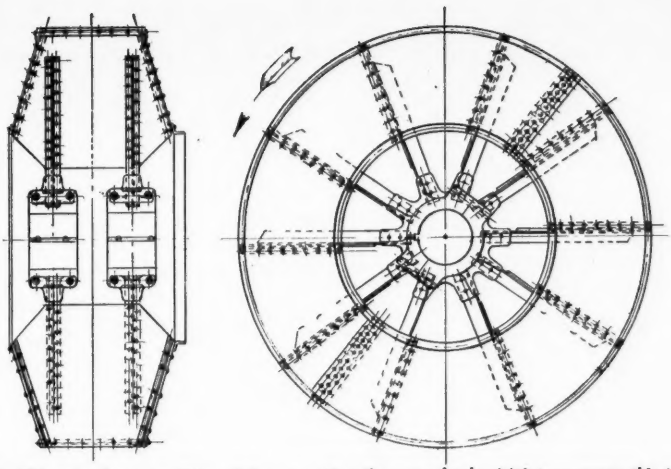

Fig. 3. This rotor has a partition plate separating the two wheels. Maintenance on this type of wheel was high

6. Coke oven gas alone and in various combinations

History of Fan Experience

To present a comprehensive view of the writer's experience and study of induced draft fans and with emphasis on fan wheels, reference is made to a plant equipped with six, large four-drum Stirling type boiler units. Each unit is served with one double inlet, double width type induced draft fan, each driven by variable speed a-c wound rotor type motors. Figures 3 to 6 inclusive cover the wheels used in these fans from 1927 to present time.

The wheel in Fig. 3 represents one of two wheels installed in one induced draft fan housing with a partition plate separating the two wheels. The reason for the partition plate was due in a measure to a design of the duct work leading to the fan, size of fan (considered very large in 1927), high temperature of flue gases passing through the fan (around 700 F), this additional stiffening member was added. It was also thought that perhaps more uniform directional gas passage would result, with less abrasive wear of the wheel.

Maintenance on this type of fan wheel from 1927 to 1941 was high and the fan blades were renewed complete once in each 13,000 actual operating hours, and they were conditioned as required at each regular boiler outage. One complete set of new wheels (2) were installed in each fan housing of four boilers between 1927 and 1941, due principally to worn hubs and spider arms, worn dangerously thin from erosion by fly ash.

In 1941 it was decided to install a more modern design and sturdy type of wheel as indicated in Fig. 4. Among improvements arrived at, we found that by using a section of renewable ribbed floor plate liners on the fan blades, we have been able to extend the useful life of the base blading to the life of the wheel proper. Renewable liners will require replacement after about 8500 hr operation. (This covers approximately the regular outage schedule.)

In 1937 two of the six boiler units were revamped for purpose of more than doubling the rate of steam output per hour, per unit (2). This revamping involved new and larger induced draft fans. The general design of the wheel agreed on was quite a departure from previous fan wheels and its use over approximately 25,000 operating hr proved it to be quite satisfactory and wheel maintenance costs were relatively low. In 1941 we improved the design of this wheel and one new wheel was installed. This latest design is shown in Fig. 6. This design of fan wheel has so far proved to be very efficient and highly satisfactory.

In Fig. 6 it will be noted that the full wheel center plate has been cut away at each blade space, thus permitting the effective blade face to extend the full width of the wheel. (The blades are still of two section construction same as the wheel blading shown in Fig. 5.) Each set of blades are entirely covered with a renewable wearing plate and while we have found it necessary to renew wearing plates once each 8000 hr of operation, we have found from experience so far that after 25,000 hr of operation, we may expect to renew all rivets in the wheel hubs where they are connected to the center plate.

The fan wheels of design indicated by Figs. 5 and 6 are normally required to handle four to five times as much solid materials in the various forms of fly ash as the wheel design, Fig. 4. Also Figs. 5 and 6 wheels have a higher peripheral speed, due to the increased draft requirements. Considering this duty the wheels indicated in Figs. 5 and 6 to all intents and purposes should wear out in half the time required for those shown in Figs. 3 and 4. The fact that they do not proves one point, if no other, i.e., when the fan designer and manufacturer are made fully and completely conversant with

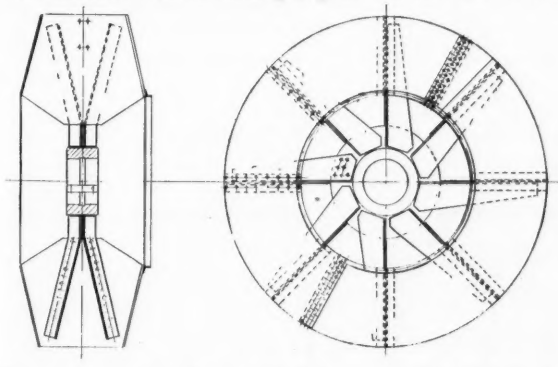

Fig. 4. This more sturdy type of wheel gave much better service than the one shown in Fig. 3

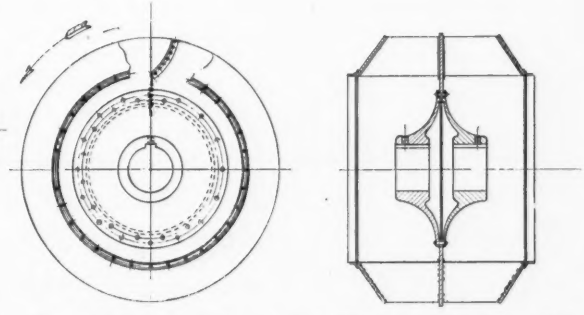

Fig. 5. Another type of wheel used. This also is of the two section construction

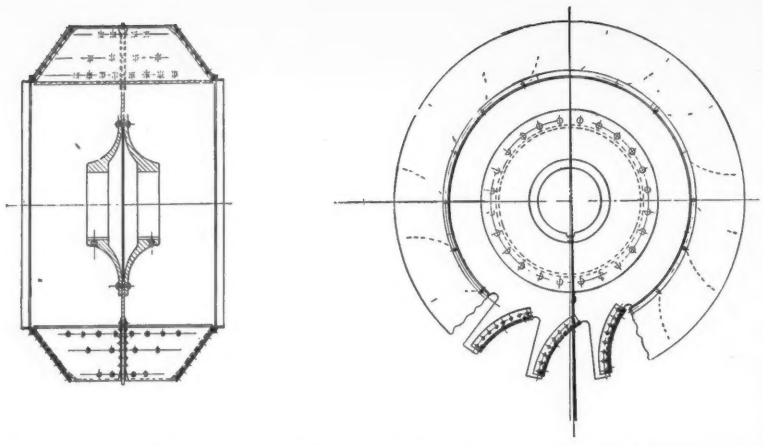

Fig. 6. In this wheel the full wheel center plate has been cut away at each blade space. This permits the effective blade face to extend the full width of the wheel

the operation they can and do utilize their ability to produce induced draft fans which not only perform in a highly satisfactory manner, but can be maintained by competent mechanics at reasonably low cost.

The fan wheel shown in Fig. 7 indicates another design of wheel which we have had in use since 1939 serving two boilers fired with pulverized coal, one boiler fired with pulverized coal and dirt saturated hot blast furnace gas, and three boilers fired with hot, dry, dirty, blast furnace gas alone and in combination with Bunker "C" fuel oil and/or fuel oil alone. Sometimes coke oven gas is used as a secondary fuel.

Use of Protective Wearing Strips

This design of wheel came to use on the first two units without any blade protection with the result that after about 8000 hr of operation a complete new set of blading was required. In this instance there was also noted considerable abrasive wear on either side of the center plate at points where the blading jointed with the center plate. There was also some abrasive wear to the outer flanges of the wheel. The worn places on center plate and outer flanges were filled in with electric weld and then dressed to their original surfaces. Renewable blades were equipped with wearing strips, and a series of welded ridges were placed on each blade. These new blades were installed as indicated in section shown in Fig. 7.

Great care was taken to assure that all fillet welding was continuous and entirely closed the spaces between the blade and the center plate and outer flanges. This is important as any crevices induce abrasive wear. The welded ridges apparently force the abrasive cinders away from the surface of the blading and otherwise tend to break up their directional flow to the point that the easily replaced ridges take the abrasive action of the flue gases, etc., hence it is not possible to get so much of the scouring action on the face of the blading, center plate and outer flanges as formerly. The procedure followed, in working with the fan manufacturer and our own operation and maintenance forces, has provided a design of wheel from which may be expected the following schedule of service between full sets of blading renewals only:

1. Burning powdered coal alone, 13,000 operating hr
2. Burning powdered coal in combination with dirt, saturated hot blast furnace gas, 17,000 operating hr
3. Burning hot, dry, dirty blast furnace gas alone 35,000 operating hr
4. Burning hot, dry, dirty, blast furnace gas in combination with Bunker "C" fuel oil, 43,000 operating hr

Renewal of complete wheels may be desirable each 4 to 5 yr of operation as there will be sufficient wear to center plates, outer flanges, center hubs and hub rivets to justify comprehensive replacement and wheel rebuilding.

Fan Maintenance Varies on Identical Boilers

We have found from an analysis of experience with several, to all intents and purposes alike, induced draft fans serving identical steam generating units that no two fans, over a five year period of normal service will have required within 20 per cent the same maintenance. Actual operating hours of steam generators, with their resultant loads, together with fan operation will be within 10 per cent, one with the others. The maintenance costs develop to be within a range of 15 per cent, one with the other. This difference in maintenance costs may be due to the various types of maintenance work required on the unit. Our belief in this difference of wear in identical fans is due mainly to the operation of the individual steam generating unit, load swings, actual fuel being fired, soot blowing schedules, induced draft fan controls, all have a definite bearing on the products of combustion and its

(*Continued on page* 134)

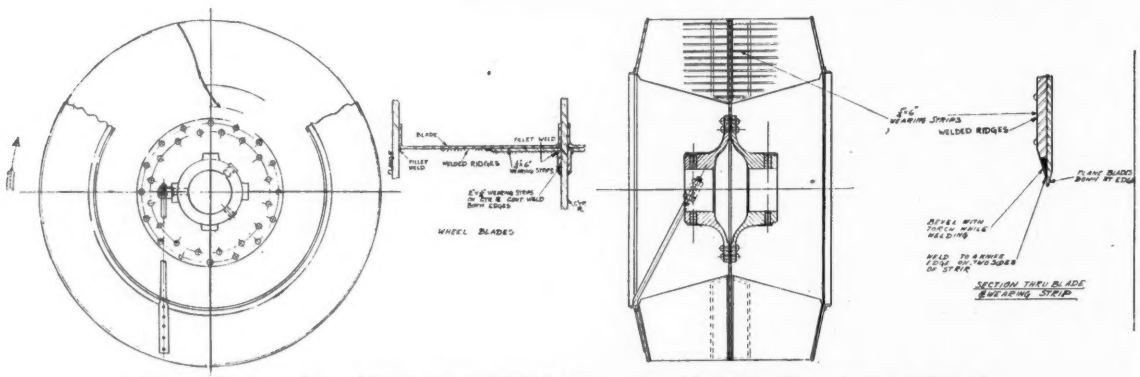

Fig. 7. The type of fan wheel used since 1939, showing wearing strips installed to protect against abrasion

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

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MORE COMING

We ask that you give particular attention to the first article in the P. E. & E. Section this issue because it is one of several which Mr. White is going to write, and they are of the type which are of especial interest to operators. This one describes the trials and tribulations encountered in revamping the old heating system at the Provincial Hospital at Ponoka, Alta., where Mr. White is chief engineer. In other articles to come he will describe the power plant itself and what was done to put it in condition. Like the one on the heating system presented in this issue, these articles are more than plant descriptions; they describe operating conditions and give reasons for changing and improving them. You will find them all interesting and practical.

A resident of Canada, but born in New Zealand, Mr. White is conscious of the friendly spirit that exists between the United States and Canada, and expresses his feelings nicely in the following paragraph taken from one of his letters.

"I have spent a great many of my vacation periods motoring through the Western part of your country, and as far as I am concerned the present state of affairs is an ideal one, as each help to rub the rough corners off the other. While I was born in New Zealand, my sister who was born in Australia, and lives in Berkeley, California, is a citizen of the United States. What more, would you want than that?"

A. W. K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Revamping Old Heating System Is No Cinch

If anybody thinks that the job of an operating engineer in a large institution is a bed of roses, this account may alter his opinion. We don't know where designers go after they leave this earth but if there is any justice, designers of heating systems such as the one described by Mr. White should go to a place where they would have to operate them for a million or two years at least. That might teach them that things should be designed so that operators can get at parts if something goes wrong. It certainly is no cinch to revamp an old, rundown system such as the one described in this article but with patience and perseverance (an inordinate amount of it) it can be done. Read Mr. White's tale of woe and then sit back and applaud him, long and loudly. Ed.

By Wm. S. White

Chief Engineer, Provincial Mental Hospital, Ponoka, Alberta, Canada

THE SHORTAGE of fuel has brought the generally accepted methods of economical use to be supplemented by what might be called downright Scotch thrift, with the fuel supply stretched out as far as it will go. In the type of plant where by-product power is obtained from the steam, but heating of buildings, domestic water, together with supplying process steam, are the main fuel cost, it is probable that the engineer in charge in most cases, while expected to produce steam economically as he may with the plant, would, until the present situation arrived, have had very little to say regarding the use of the steam economically. The question of how thriftily the products of the power plant might be used, the engineer having provided for as little wastage as possible in the distribution, generally does not come within the control of the engineer, and is a responsibility of management.

The extravagant use of fuel in the heating of buildings is all too common, and in this respect, the Mental Hospital owned and operated by the Provincial Government of Alberta, Canada, at the town of Ponoka, was no exception until quite recently. This hospital was started like many others, with first one building, then another, and so on, until there are, roughly speaking, 12 major blocks of two-story buildings scattered over an area of approximately three quarters of a square mile, interconnected mostly by corridors, the power plant (which I do not purpose to discuss in this article), making the 13th block, and situated close to the first buildings erected. In the general development, there is no evidence that any systematic plan was followed in the design of the heating system, the layout in each new building being different from the others. In some buildings no basement was provided, pipes were laid beneath the floor, buried in the walls, carried up through the walls into the attics. In the earlier buildings, the single line system, with vacuum airlines buried in the walls, presented quite a problem later on, when these ¼ in. lines running from each radiator became choked with rust. Main steam lines, branch and return lines, in many cases, were difficult to get at, and in one case, a tunnel had to be driven through the earth underneath one building to get at the branch steam and return lines.

The Chief Engineer Was Responsible

At first when I became chief engineer, my duties were confined to the power plant proper, and with the condition it was in, this was quite sufficient. Finally when 15 psi back pressure had to be maintained at the plant on the heating system, and this failed to heat some of the buildings, it was suddenly discovered that the chief engineer was responsible for the heating system. It was soon found that in those sections of the buildings which would not heat, the airlines from the radiators were not functioning, as they had corroded up internally, and these were buried in the walls. The only immediate method that presented itself was to try and force them clear with water under pressure. To do this successfully, a hand pump had to be made similar to a boiler inspector's, and in many cases, the pressure had to be raised to 2000 lb before the line would clear. Luckily enough with few exceptions the lines stood the pressure without bursting. With the air removed again from the radiators, a partial restoration of heating service was brought about. In two buildings it became evident that the steam supply was insufficient, and when the branch lines at the main supply line were broken open, it was found that very little steam issued from the main line. While heavy deposits of mud and oil had been removed from drainage traps on the distributing system, which were few and poorly located, it was a surprise to find (after a section of the main had been removed with some difficulty at the point of non-supply) about 20 ft of it practically sealed off with an oily mud. The question arose as to whether further similar deposits would be found in other parts of the system. Wherever it was possible, the other distributing mains were checked for blockage, but nothing was discovered.

A study of the steam heating mains as they were, and after additions had been made for new buildings, pointed to the continuous collecting of undrained condensate in the section of the main that silted up. After the line was cleaned, the installation of a 1-in. drainage trap, with the discharge open to the atmosphere, showed that condensate collected heavily at this point. As further difficulties with the heating system were tackled, and overcome at least temporarily, it became apparent that the steam heating system together with the branches would be adequate, if the return system was revamped and a steady vacuum maintained on it at the power plant. A check up of the direct heating surface in radiators in the various buildings showed generous estimation with few exceptions, and taking into consideration all the scattered items, the equivalent heating surface was placed at 80,000 sq ft, and the space to be heated at 4,280,000 cu ft.

The outside wall construction in general was substantial, all major buildings, with the exception of one being of fireproof construction. Provision was made to keep a record of the degree days, by providing a thermometer placed some distance away from the power house, which registered the maximum and minimum temperatures, and this was ready and reset every eight hour shift by the engineer, and recorded in the log sheet, together with the weather conditions, direction and velocity of the wind. It was found that the total degree days per year agreed closely with the Dominion Experimental Farm record kept about 20 miles distant from the hospital, although this was not found out until sometime afterward.

Use of Steam Excessive

With the degree days as a base, it was established that the heating steam being used was much in excess of that necessary, but until the return system was changed, nothing much could be expected in reduction of steam consumption, and to promote this more flexibility in the heating system was desirable. A piecemeal revamping of the return system to the vacuum pumps at the power plant was started, and those parts of it that were inaccessible were discarded and left as they were, the new sections being installed in the most convenient and accessible way possible, and single piped radiation converted to two pipe. At first considerable objection was met to these alterations, but the work was proceeded with, and later considerable assistance was given to finish the job—all this over a period of years.

In the meantime the quality of the steam produced by the boilers was improved by maintaining much lower densi-

ties in the boilers. Wet steam has no place in a heating system, or steam engines, as more cylinder oil will be used, and this will find its way into the heating system with exhaust steam. The separation of the moisture and oil from the exhaust of the steam engines driving the generators, pumps, etc., was gone into carefully, and as provision had to be made for larger lines to carry more steam to larger domestic hot water heaters replacing the older ones. A double exhaust-pipe system was worked out, with the older exhaust-pipe system underneath in the engine room basement, and the newer system overhead, with the baffle type oil and moisture separators that were originally provided, reinstalled close up to the heating system header.

Since this arrangement was made, there has been scarcely any indication of oil or entrained moisture getting into the heating system, as shown by the trap discharge. The loop provided by the basement exhaust piping, collects a large amount of the oil and condensate from traps installed at points considered necessary. As a final provision, the discharge from these traps, and the separator traps were piped to a collecting tank in the basement, and this tank was provided with an up and down pass through a coke bed to separate the oil besides keeping tab on the oil being used. This tank recovered about 10,000 lb of good feedwater every 24 hr, and gave a good check on the moisture and oil being kept out of the heating system. This tank also provided means for boiler water treatment as the alumina sulphate used for coagulating the oil and separating it from the water helped the sodium sulphate required in the boilers. The water supply is of the temporary hardness class.

The drying up of the steam, and reduction of oil entering the heating system was very encouraging. Systematic examination of traps on the heating system showed less and less indications of oil and dirt. The back pressure on the heating system gradually dropped until ¾ of a lb was sufficient in cold weather, and later on when the renovation of the return system was completed, it was found that the heating of the buildings was sufficient in cold weather if the back pressure was carried at atmosphere, and 10 in. of vacuum maintained at the vacuum pumps.

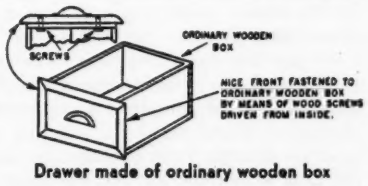
In spite of opposition and little encouragement, the planning and effort, over a number of years, was, as events have turned out, found to fit in nicely with the war effort and the fuel situation, as the following condensed tabulation proves. The eight year period starts with the year 1933, when a full year of degree days was logged for the first time, and this also is the year when the piecemeal revamping of the returns began. Therefore, the amounts given are not as high as they would have been if the degrees had been kept before 1933. The year 1941 is left out, owing to my absence and the record not being completed.

	Total steam produced by boilers per deg day	Heating domestic water & Bldgs	Heating Bldgs. alone
8 yr period	11,280 lb	8,740 lb	6,800 lb
Year 1942	10,203 lb	7,500 lb	5,380 lb
Year 1943	9,500 lb	6,700 lb	5,090 lb
8 yr period and 1943 reduction	15.8%	23.4%	25.1%

Saving Lumber

By J. R. Kennedy

RECENTLY in expanding a plant it was necessary to build a number of wooden drawers for use in the storage and tool rooms. Only medium sized drawers were required, but they were essential to the proper care of various articles essential to the operation of the plant. Lumber of the desired size, grade, etc., was not available due to the recent "freezing order" on lumber, but the problem was solved nicely in the following manner: In addition to a few good planks, a number of ordinary wooden boxes were found in the "junk room." From the full-length planks, the required number of drawer "fronts" was made. (See sketch.) These fronts were fastened to the "boxes" by means of wood screws driven through the box and into the inner or hidden side of the front. (Nails of the proper lengths can be used if wood screws are scarce.) After all available factory-made boxes had been used, scraps of lumber found scattered around in unused corners were gathered up. From this enough more plain "boxes" were made to meet the requirements. By fitting neat fronts on the boxes and attaching drawer pulls, all unsightly work was hidden, presenting an appearance good enough even for an executive's desk. Thus lumber was saved, money was saved, and the plant cleaned up in this emergency.



Drawer made of ordinary wooden box

"We appreciate your bringing your typewriter oil can along, Miss Lovelace—but I'm afraid it won't do for your new job here"

MEGAVARS—How They Act and Why

There must be something inherent about power factor that makes it difficult for the human mind to grasp. The question of power factor has been under discussion ever since the first a-c system went into operation and, probably, it will continue for a long time to come. A short time ago, in the March issue[1], a reader asked a question about the effect of manipulating the generator field on a system that contained a regulated synchronous condenser. He wondered whether it would make the reactive power leading instead of lagging. The question brought forth considerable comment, some of which was presented in the Q & A Section, but this comment on the subject by Mr. Tinker is so comprehensive and so clear that we feel it deserves a place by itself. So we present it here. One of the things that Mr. Tinker points out is the often misunderstood fact that an overexcited synchronous machine does not necessarily supply leading reactive power. If the load is lagging, overexcitation of such a machine will merely cause it to carry its share of the lagging component of the load

By CARL C. TINKER

THE OPERATION of synchronous machines under varying conditions involving leading and lagging power factors is often confusing to power plant men as well as to some engineers and superintendents in charge of plant installations. Small generators operating in parallel with a hi-line, synchronous condensers strategically located in a network, synchronous motors running loaded and the common arrangement of a generator and condenser serving the load from one location all present problems pertaining to power factors and reactive loads which for the greater part may be solved to the satisfaction of the average plant engineer without recourse to complicated current and voltage vectors.

A question pertaining to this subject which was asked by R. F. L. in the March issue of POWER PLANT ENGINEERING throws the spotlight on an incident which was observed by the writer during the installation of some new switchboard equipment in a small plant in Michigan. The design and layout of the plant included a 500 kva engine driven alternator arranged to operate in parallel with a hi-line and was supervised by engineers who were supposedly familiar with all phases of such installations. Among the switchboard instruments were kvar and power factor meters connected in the generator leads to record and indicate the amount of reactive load that the machine would carry and to determine the economic limits to which overexcitation might be carried without the sacrifice of kw capacity. When the machine was put on the line, however, and the field excitation increased, the instruments indicated a lagging power factor, and the more excitation that was applied, the more lag was indicated. Considerable consternation was evident among the supervisory personnel who seemed to expect something different, and the operator, thinking that maybe he was turning the rheostat in the wrong direction, turned it the other way until the power factor meter was seen to return to zero and finally indicate a fair amount of leading current. At about this time the machine began a series of hunting oscillations which threw the instrument needles wildly from one end of the scale to the other and finally opened the breakers, freeing the machine from the line.

No one cared to make any statement until connections had been checked, slide rules dragged out and vectors drawn, after which, of course, every one admitted that they knew all the while that everything was just as it should be. The alternator simply was carrying its share of the lagging component of the load under normal field excitation and should show a lagging power factor. As a matter of fact the condition of overexcitation of a synchronous machine had, in the minds of this crew, always been associated with a leading power factor although any experienced switchboard operator could have explained the error.

It must be said, however, that few textbooks make clear the difference between the leading power factor of a synchronous condenser and the lagging power factor of an alternator, both furnishing kvar to the same load, perhaps because it is assumed that the student should be sufficiently versed in his theory to permit him to visualize the difference, or maybe because the whole thing isn't so clear after all. For the operator of synchronous machines perhaps the simpler viewpoint is that which sees both the generator and condenser supplying a share of the lagging reactive load since this is actually the normal condition and an in-

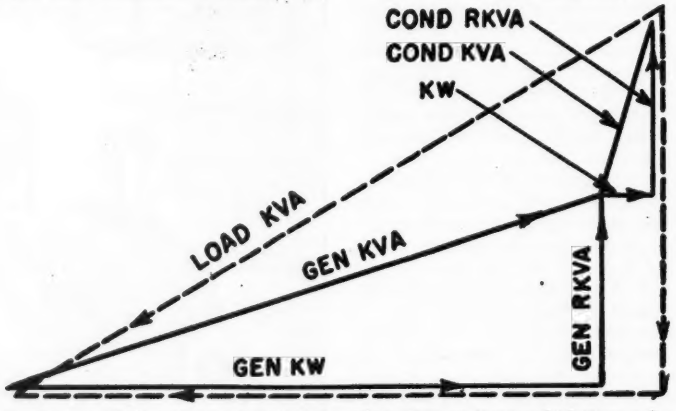


Fig. 2. Vector relations of a system similar to that of Fig. 1 but in which the synchronous condenser is driven by a prime mover

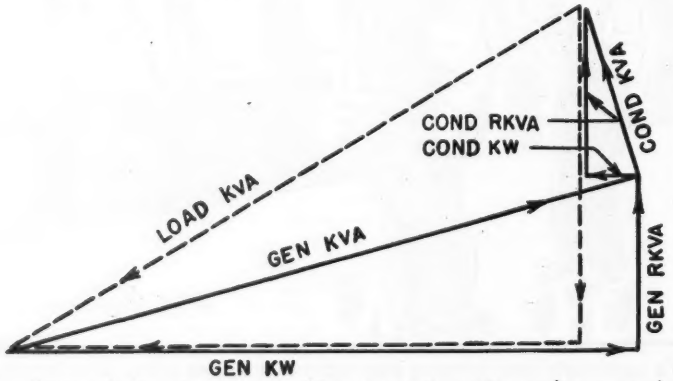


Fig. 1. Vector relations of a system involving a generator and a synchronous condenser

[1] Question No. 252.

crease in excitation of either machine will cause it to supply a greater share of this component.

Generator and Condenser Both Supply Lagging Power

This condition is illustrated in Fig. 1 where we see the generator kw and kvar added to the equivalent components of the synchronous condenser to make up the requirements of the load kva which, with its components, has a vectoral direction opposed to that of the source of supply. Note that the generator kw exceeds the load requirements by the amount of power absorbed by the condenser and that the direction of power flow is outward from the generator and inward in the condenser. Owing to this we say that the generator is supplying a lagging power factor and that the condenser is drawing a leading current from the line while as a matter of fact the kvar vectors of both machines have the same direction and add up to supply the lagging component of the load. Power factor meters connected in the leads of the respective machines will indicate a lagging condition in one case and leading in the other simply because of the difference in the direction of power flow.

To illustrate the point further, assume that power is applied to the shaft of the condenser and that the angular position of the rotor is advanced until no kw is absorbed from the generator and therefore this component of the condenser triangle falls to zero. Upon further application of turning effort to the shaft the condenser kw rises to an appreciable amount in the opposite direction and the machine becomes a generator. Such a condition is shown in Fig. 2 and a lagging power factor will be indicated here because the power flow has reversed and is now lagging with respect to the kva, although the kvar has not changed at all. The purpose in stressing this point is to show that the two methods of supplying the reactive component of the load is, for all practical purposes, merely a matter of terminology, the relatively small amount of kw absorbed by the condenser having no particular bearing on the situation other than to make up the losses in this machine.

What Happens When P.F. of Controlled Condenser Is Leading

The question of what happens when the power factor of a generator is made leading while operating in parallel with a controlled voltage condenser is easily answered by experiment if the operator cares to try it, but he should be prepared for a service interruption since an extremely unstable condition may result from the weakened generator field. Of course a great deal depends upon the load and the relative capacity of the two machines. If the condenser has sufficient capacity to pick up the reactive load only to the point where the generator has dropped all of this load and is operating at unity power factor, then the voltage on the system will drop as the generator field is further weakened and an unstable condition may result at any time thereafter. If the condenser has the capacity to carry on to the point where it is supplying the lagging reactive component of the load as well as absorbing the leading current put out by the underexcited generator, then an interesting problem in terminology develops.

If the conception of a generator or condenser supplying the load is adhered to, whether it be kw or reactive, leading or lagging, then the whole situation may remain clear. Increasing the excitation of any such machine will compel it to supply a greater portion of the lagging requirements of the load, provided that the voltage is held constant by some other source. Conversely, if the excitation of any one of these units is reduced until its power factor reaches unity, and then is continued beyond that point, this machine will supply a leading component up to the capacity of the constant voltage source to absorb it. This constitutes a reversal of flow of the reactive component in this machine and actually adds to the system requirement for more lagging component which must be supplied by the constant voltage source. This is shown clearly in Fig. 3 where the kvar of the underexcited generator is added to the lagging kvar of the load.

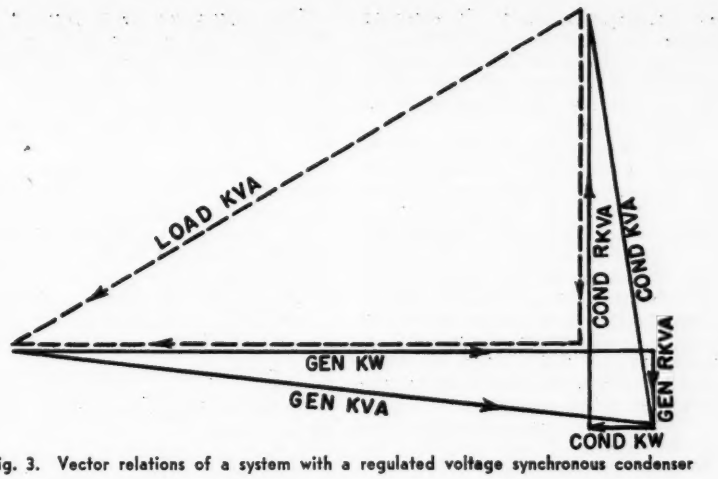


Fig. 3. Vector relations of a system with a regulated voltage synchronous condenser

Planning Factory Steam and Power Supplies

In an editorial in the April issue, we stressed the need for planning now for post-war power plant expansion and rehabilitation. Also, we pointed out that if you did not have manpower available to make the necessary studies, there were plenty of consulting agencies available to help you out in such work. Here, in this article, a consulting engineer discusses this subject. He shows how to make an analysis of the factory steam and power requirements and gives two examples, each involving three possible solutions. This article should be of particular interest in that it deals with the small type of industrial plant

By William A. Gaylord Consulting Engineer, Hamden, Conn.

THE START of the Defense Production Program about four years ago found many plants with steam and power supply systems that were nearing the end of their economic usefulness. Since then the scarcity of materials and equipment has made it necessary to keep many of these in operation by whatever means possible regardless of whether or not it was the economical thing to do.

While materials and equipment are still unavailable for most civilian uses it is not too early to give serious consideration to what should be done when they become available.

The best way to start will be to make a careful analysis of the services the factory will require and their relative importance. These will include steam for building heating and any processes requiring steam or hot water, as well as electrical energy for power and light.

This analysis should show the maximum, average and minimum requirements for each of these services and whether the maximums and minimums occur at the same or at widely separated times. Any special requirements such as a high instantaneous demand for steam, compressed air or electricity should also be noted as this may materially affect

the equipment required. If extensive summer air conditioning is necessary it will be advisable to consider whether the steam capacity used for winter heating would be sufficient to supply the refrigeration required.

With this analysis available it will be possible to determine first whether it will be advisable to generate or purchase power. This will depend first, on whether a reliable source of Central Station power is available at a reasonable cost; second, on whether there is sufficient demand for low pressure process steam to make the generation of by-product power economical and third, on the power load factor which will determine whether Diesel engine driven generators should be considered.

To do this, estimates should be made of the costs of all plant services under the following conditions:

1. Where low pressure boilers are used to supply steam for heating and process only, and all power is purchased.
2. Where high pressure boilers are used and all power required is generated in back pressure or bleeder type turbogenerators.
3. Where low pressure boilers are used to supply steam, and power is generated by Diesel engine driven generators with or without heat recovery from jacket water and exhaust gases.

Under unusual conditions such as a large demand for compressed air, it may be necessary to study other combinations involving the use of steam or oil engine driven air compressors while other power is purchased.

A careful comparison of these estimates should show which type of plant will be most suitable for the conditions.

When the type of plant has been chosen it will then be necessary to consider what equipment will be required, the capacity of this equipment to meet present and anticipated future loads, the most suitable location for this equipment, whether any of the existing equipment, piping, wiring, etc., can be utilized, and if so, what changes in it will be necessary, and whether a new building will be required.

Before the actual equipment can be chosen it will be necessary to consider the following:

1. What types of fuel are available; their relative costs and the reliability of the supply of each type.

2. What facilities will be necessary for receiving, storing and handling each type of fuel and the space available.

3. If power is to be purchased, at what primary voltage it will be delivered.

4. At what secondary voltage power will be distributed to motors from various load centers.

5. Whether there shall be a single sub-station with power distribution to load centers at secondary voltage or whether there shall be individual substations at load centers with distribution from service connection to load centers at primary voltage.

6. If power is to be generated, at what voltage it will be generated and distributed to load centers as above.

7. If compressed air is required, at what points and in what quantities and at what pressures. Whether compressors in power house with piping system to distribute to all parts of plant or individual compressors at load points will be more suitable.

8. If hydraulic, refrigeration or air conditioning systems are required their capacities, types and locations.

To show the application of these methods examples taken from two plants recently studied are given.

The construction work on Example I is still in progress, while the equipment for Example II has been in use about three years.

Example I

A factory making metal goods. (Now all war work).

Uses steam for heating and process.

Buys all power at secondary voltage (220 v).

Uses some compressed air.

No hydraulic, refrigeration or air conditioning systems at present. Possible summer air conditioning to be considered for future installation.

Present building heating load about 14,000 sq ft equivalent direct radiation.

Present maximum process load 2500 lb per hr at 40 psi gage.

Probable maximum future process load 3500 lb per hr.

Present maximum steam demand about 6700 lb per hr.

Probable future maximum steam demand about 10,000 lb per hr.

Minimum steam load when plant is operating 500 lb of steam per hr. Average summer load about 1500 lb per hr.

Present boiler capacity consists of one 75 hp Scotch marine located in lean-to and one 4500 sq ft sectional C I boiler in office basement; both fired with No. 5 oil, and having a probable maximum steam output of about 5500 lb per hr. Both boilers in poor condition.

Electric load for last year of operation on civilian goods where resistance welders were used was:

Measured demand 180 kw, Billing demand 275 kw, Energy 780,000 kwhr. (½ second demand about 150 per cent of 15 minute demand.)

At present three 100 kva transformers supplied by Utility supply service through 1600 amp circuit breaker. Mains connected to this through fused cutouts.

Two motor driven 10 by 9 in. at 325 rpm air compressors installed in inaccessible space. One carries load, other as spare.

Maximum steam and electric loads do not occur at same time.

Plant is so compact that only one main distribution point for secondary voltage current is required.

No space is available in existing buildings for additional boiler equipment.

Plant location such that fuel must be delivered by truck.

Below estimates of annual operating costs for three types of plants are given:

1. Generating Steam at low pressure and Purchasing Power.

Estimated cost of Boiler Plant $50,000.00 (new building). Boiler arranged for automatic operation and no full time attendant.

Fuel (oil or coal)	$11,250.00
Labor	1,000.00
Supplies	200.00
Maintenance	300.00
Purchased Power 780,000 kwhr at 1.75c	13,650.00
Taxes, interest and depreciation $50,000.00 at 11 per cent	5,500.00
Total	$31,900.00

2. Using high pressure boilers with bleeder type turbine of 300 kw capacity to generate all power and steam required.

Estimated cost of Power Plant (new building) $90,000.00. This plant will require attendant 24 hr a day.

Fuel	$16,875.00
Labor	7,500.00
Supplies	350.00
Maintenance	700.00
Purchased auxiliary power 12,000 kwhr at 5c	600.00
Taxes, interest and depreciation $90,000.00 at 11 per cent	9,900.00
Total	$35,925.00

3. Using low pressure boilers for heat and process steam and Diesel Engine Driven Generators for power. Four 100 kw units installed.

Estimated cost of Power Plant	$100,000.00
Fuel (boilers and engines)	19,000.00
Labor	7,500.00
Supplies including lub. oil.	800.00
Maintenance	1,000.00
Purchased auxiliary power 6000 kwhr at 5c	300.00
Taxes, interest and depreciation $100,000.00 at 11 per cent	11,000.00
Total	$ 39,600.00

This analysis and these estimates clearly indicate that in this case it will not be economical to generate power and that a boiler plant to supply heat and process steam only should be used.

A new boiler house will be required as there is no room for additional equipment in present lean-to boiler room and it is poorly located.

The present boiler is of the Scotch marine type and in poor condition so that a new unit to supply the whole load will be advisable.

The location of the plant is such that any fuel will have to be delivered by truck.

The load on the boiler will vary from minimum of 40 hp for process steam in summer to a maximum of 240 hp in cold winter weather. Provision must be made for a future maximum capacity of 335 hp.

The use of No. 6 fuel oil with a full automatic burner will be desirable to reduce attendance labor to a minimum.

As an alternate coal firing on a single retort underfeed stoker which would be

equipped with automatic combustion control and a large hopper could be used.

In any case the type of boiler chosen must be such that oil burner can be replaced with coal burning equipment should oil become unobtainable or too expensive.

All condensate from the heating system and about 75 per cent from process steam are returned to boiler so only a small amount of make-up will be required but as raw city water must be used for this, some sludge in the boiler must be expected. For this reason a boiler to operate at moderate rating and with a large water content will be desirable.

A 78 in. by 18 ft 0 in. hrt boiler rated at 211 hp will meet all of these requirements if equipped with an oil burner to operate it up to 175 per cent of rating.

As it will be necessary to build a new boiler house it will be advisable to build it large enough to provide for a second boiler unit and also to provide space for the present air compressors which are now located in an inaccessible space where they do not get proper attention.

The space available for a new boiler house is on higher ground than the present buildings so it will be necessary to use condensate pumps to return condensation from heating system and process equipment to boiler house.

The present boiler operates at 50 to 60 lb gage pressure and as the new boiler is to be at some distance from the process equipment a working pressure of 60 to 65 lb gage will be used.

The city water pressure at this plant is 70 to 75 lb gage so that an automatic emergency boiler feed controlled by a Magnetrol unit can be installed to admit city water direct to the boiler if the water in boiler gets below the safe point.

The regular boiler feeder will be an automatic pumping system consisting of a receiver tank with float operated make-up valve and thermostatically controlled steam heater to maintain a temperature of 205 F in the tank to drive off as much as possible of the free oxygen and CO_2.

The pump will be controlled by a second Magnetrol set to maintain at least 1 in. higher level than that controlling the emergency feed.

New steam and air mains will be run from the boiler house to the various buildings and return main from building to boiler house.

The electric supply will be left unchanged for present as extensive changes are expected to be necessary when reconverting from war work.

The object to be gained by this plan is to provide a reliable supply of steam of sufficient capacity rather than any saving in operating costs over present operation.

Now let us consider another plant where savings in operating costs are the prime objective.

Example II

A factory making metal products on automatic machines of various types.

Uses steam for cleaning, drying and processing metal parts.

Buys all power at secondary voltage through one bank of transformers. When built factory used generated power from steam engine driven generator, but has outgrown and abandoned this.

Secondary voltage is now 220 v but distributing mains from switchboard to load centers are overloaded and some are so long that there is a serious line loss.

One small motor driven air compressor supplies all compressed air required.

Boilers, two 150 hp, hrt equipped with travelling grate stokers which are 31 yr old.

Factory heating system recently rebuilt using unit heaters operating at 40 lb gage for all space outside office.

Records for year before survey was made show use of 1040 tons of coal and 1,163,000 kwhr of energy at a maximum demand of 345 kw.

Survey showed steam heating load to vary from 0 to 7000 lb of steam per hr and process load from 500 to 2500 lb per hr.

Boilers appeared to be operating at an average efficiency of about 60 per cent and to have produced about 16,500,000 lb of steam in year.

Plant runs 16 hr per day and power load on second shift is about 60 per cent of day load.

Boilers although 31 yr old are in fair condition except that one must be retubed.

Stokers are completely worn out and must be replaced if boilers are to be kept in operation.

Both boiler room and engine room buildings are in good condition and can be used to house new equipment if desired.

A fair supply of condensing water is available with intake pipe from stream to well in corner of engine room basement.

There is little increase in plant power or steam loads expected.

A rail siding is available and space to store 500 tons of coal where it can be conveniently taken to boiler house by simple monorail system.

The existing boilers are set too low for a satisfactory installation of modern stokers but oil burner to use No. 6 oil could be installed with relatively few changes in setting. If automatic burners were installed and one boiler retubed the present boilers could be expected to supply all steam required for heating and process for at least 10 yr.

Preliminary studies showed that the steam and power loads were fairly well balanced for the use of a high pressure boiler supplying a bleeder turbine which would carry the whole power load and from which sufficient steam could be bled at 40 lb gage to supply all heating and process requirements.

To determine what type of plant will give most economical operation estimates of annual costs with three different types of plants have been made as follows:

1. Install oil burners and repair present boilers.

   Continue to purchase power. Estimated investment $10,000.00 and remaining life of plant 10 yr.

Labor—One Engineer and two Watchmen (part time)	$ 2,500.00
Fuel—150,000 gal oil at 4.5c	6,750.00
Supplies, etc.	200.00
Maintenance	250.00
Purchased Power—1,163,000 kwhr at 345 kw demand	18,600.00
Interest and depreciation—15 per cent on $10,000.00	1,500.00
Total	$ 29,800.00

2. Install one new boiler to operate at 300 psi gage with 600 F total steam temperature with capacity of 16,000 lb of steam per hour fired by stoker; one 400 kw bleeder turbo-generator with condenser and one 50 kw auxiliary turbo-generator to generate all power. Estimated investment $65,000.00 and plant life 20 yr.

Labor—One Engineer and one Watchman (part time) Two Firemen full time	$ 5,500.00
Fuel—1400 tons of coal at $7.00	9,800.00
Supplies	400.00
Maintenance	700.00
Interest, taxes and depreciation 11 per cent on $65,000,00	7,150.00
Total annual power and steam costs	$ 23,550.00

3. Install oil burners and repair present boilers; install 5—100 kw Diesel engine driven units to supply all power. Estimated investment $70,000.00.

Labor—One Engineer and one Watchman (part time). Two Engine-Operators full time	$ 5,500.00
Fuel—Engines and boilers, 150,000 gal at 4.5c 120,000 gal at 7 c	15,150.00
Supplies, including lub. oil	800.00
Maintenance	1,000.00
Interest, depreciation, taxes, etc. 11 per cent	7,700.00
Total	$ 30,150.00

This clearly shows that the steam turbine driven generating plant will give the lowest overall operating costs.

A further study of the electric power system shows that it will be desirable to increase the voltage at which power is supplied to the plant to 440 v. This will require reconnecting the larger motors for this voltage and the installation of a 5 kw transformer to supply one group of small motors. This change will cost less than replacing mains which are overloaded and give more satisfactory operation.

A study of delivered prices for coal and oil at this plant for the preceding seven years showed that the average fuel cost per 1000 lb of steam produced in equipment suitable for this plant would have been at least 10 per cent higher with oil than with coal.

The boiler capacity is too small to

make the use of a pulverized fuel system economical so the use of a single retort underfeed stoker was decided on.

As this boiler had to be installed in the existing boiler room by removing one of the old hrt boilers and it was desired to leave room for a second unit if the other old boiler was removed, the head room and width available were somewhat limited. After a study of the units available a Keeler Type C.P. of 265 hp nominal rating with waterwall furnace and bridge wall and special superheater equipped with 7 ft 0 in. by 8 ft 0 in. stoker and motor driven, forced and induced draft fans was chosen.

The stoker was equipped with two unit automatic combustion controls.

The existing stack and flue were used.

A study of the turbine units commercially available in the 500 kva size showed that a unit operating with a throttle pressure of 300 lb absolute and a steam temperature of 600 F and a back pressure of 1 lb abs with a governed bleed at 60 lb abs, would have almost as good a water rate as if the throttle pressure were 400 lb abs with 650 F steam temperature, and that the cost of the 300 lb unit would be about 20 per cent less than a 400 lb unit. As this same difference in cost applied to the boiler unit, valves, etc., the 300 lb unit was found to give the more economical plant so this pressure was chosen.

A pressure reducing valve and spray type desuperheater were provided to supply steam to the heating system when the turbine was not running.

The high pressure steam piping was made as simple and short as possible and the number of interconnections between high and low pressure systems reduced to a minimum. This plant was installed three years ago and has given very economical and reliable operation.

These two examples show that although the steam and power requirements in these plants appear quite similar before a complete analysis is made they can best be served by entirely different types of equipment and indicates the necessity of a complete study of each case to determine the equipment and plant arrangement that will give the most reliable and economical results.

While it may, in some cases, be too early to draw up complete plans and specifications for new steam and power equipment because the makers are not yet in a position to work out details of special designs, all of the studies as to what will be required and the general design of the plant can be worked out. In many cases where standard equipment only will be needed the plans and specifications can be completed and ready for use as soon as the necessary equipment is available.

LETTERS AND COMMENTS

They Ran the Engine with the Cylinder Head Off

I WOULD like to recount an interesting experience we had in running a cross compound engine with the cylinder head off the low pressure cylinder. This engine was a 2500 hp unit. The low pressure piston was leaking badly which was attributed to the cylinder being out of round. So the company had the cylinder rebored but instead of curing the trouble, it really only started. The cylinder was 70 in. in diam and the regular junk and bull ring was lined with anti-friction metal. The reboring job was completed at about 2 o'clock on a Sunday morning and everything was put back, ready to start the plant at 7:15 a.m. The engine was started at 5:30 a.m. We got the machine up to about half speed but from the noise it made one might have thought that the entire plant was falling down.

We shut the engine down and removed the cylinder head and found the cylinder walls scored the entire length. The plant had to run, so the low pressure head was removed, the reach rods disconnected from the wrist plate and the steam and exhaust valves blocked shut. Then we started up with the cylinder head off. We kept putting cylinder oil into the cylinder as the machine ran. The condenser pumps were running so the machine was running one side condensing.

The engine ran that way for a whole week. The next week the cylinder was, again, rebored and refitted with the other set of junk and bull rings but this time the rings were lined with anti-friction metal. When the engine was started this time there was no trouble.

Fall River, Mass. J. K.

Private Green's Neck Is Out

I READ your editorial entitled "Wanted, More Dope on Small Plants" in the April issue of POWER PLANT ENGINEERING and was rather pleased to see that you agreed with me in my previous letter. However, I was surprised at one of your statements. Let me quote, "In many instances he (the small plant operator) lacks the necessary enthusiasm to write an interesting article." I am going to make a few comments on that statement and in so doing I am going to stick my neck away out and tread on a good many toes. Furthermore, I just dare any small plant operator at whom this letter is directed to take a swing at that neck that I am sticking away out.

Occasionally some civilian gradually begins to realize that we are now engaged in a war in which we are fighting for our very existence. However that war is not at their very doorstep so why bother about it. Well, here is one engineer who is bothering about it. You see, I haven't got a son in this war; I'm helping fight it myself. And the quicker I can get it over and get back where I can take a bath in cylinder oil the better I will like it. (Don't think I don't long for that bath either.) So I am saying this to all these operators who have good ideas and kinks and keep them to themselves. Get on the ball and share them with other operators. After all the small plants are doing a mighty large bit of winning this war.

Maybe some of these plants are not even doing war work but let me illustrate where they can do a tremendous part in winning the war. All the figures in this illustration are assumed as I have no statistics to base what I say on. But I think they will be very conservative. Let us assume that in each of the 48 states there are 1000 small plants. That makes a total of 48,000 plants. Now let us assume that the Chief Engineer in one of these plants contrives a method by which he can save a ton of coal every day. Well, a ton of coal isn't going to win the war so why write about it, he thinks. Isn't it? Let's see. Suppose he writes to some magazine and describes his method. Every engineer in each of the 48 states tries it out to his satisfaction and immediately 48,000 tons of coal are saved each day. In one year this would figure out to 17,520,000 tons of coal. This is enough to fill 219,000 gondola cars or 2190—100 car trains. At the rate of $3 per ton this would mean an annual saving of $52,560,000. That would buy an awful heap of war bonds. And that engineer thinks that his idea for saving a ton of coal per day isn't going to win the war. In my opinion he is suffering from narrow-mindedness. He's also a dope. Go ahead, swing that axe; my neck is still out there waiting for it.

Here is another statement you made Mr. Editor, that I am going to pounce on. "Even if he has worked out operating or maintenance procedure that would be of interest to fellow engineers, he is reluctant, or feels incapable of expressing himself on paper." So he is reluctant is he? Gentlemen, get down on your knees and thank God that the boys in North Africa and Italy and Bataan and Corregidor and the Solomon Islands and hundreds of other places weren't reluctant to get up and fight and die. Stop and think where you and I would be today if they were. We would be going around paying homage to a paper hanger. Do you think that for one moment those boys felt capable of the task before them? Some did but the vast majority did not. Yet did they hesitate? Why should I answer that; you all know this answer. But what do you do about it? Sure you work hard twelve hours a day, you buy bonds, you have put your car up for the duration and you have made many sacrifices. Okay, let's compare your lot with that of a boy, perhaps your son, who is fighting in the jungle. He works 24 hr a day, he buys bonds out of his scrimpy pay, he probably walks 30 miles a day through jungle growths. But what do you do? When you get home from work you park your posterior in an easy chair and say, "To heck with that ton of coal I am now able to save every day." You feel incapable of writing? Well now, listen to this; I never went through high school but I'm not ashamed of it. I have my regrets, I admit, but nevertheless I'm writing this article.

So if you are not interested in winning this war just remember that there ARE people who are anxious to see the end of it. Write down your ideas and send them in. We can all profit by them and if we can't you at least have done your part. But let's get "on the ball."

Ft. Devens, Mass. Pvt. William Green

Baker Ready to Take On All Comers

Received the May issue and as always it's good. I sure got a laugh out of the way two fellows came back at me. I refer to Carl Bachmann and G.S.C. on page 110. First I'll work on G.S.C. Now if he wants to be specific I'll say we get our NH_3 in 150 lb steel cylinders. But around here we hear them called drums, torpedos, bullets, and other fancy names. For his further information Aqua is shipped in steel barrels also called drums. I have handled both plenty of times. The man in question was not dumb. I never said he was. But he told me he was afraid of ammonia. So much for this one. Now to work on Mr. Bachmann. I am not trying to better my status by writing but do so only to compare notes. If my ideas and comments were not so useful why did he read it? Perseverance and proper guidance is it? When I have a man on with me a solid week is it perseverance to have to tell this man each hour, each watch, what to do; when it goes in one ear and out the other because there is nothing between his two ears to stop it? His great trouble was due to the presence of another engineer with whom he had trouble in a previous plant. I actually think this knocked the props out from under him on this job. Now both men are gone. The other one was "eliminated." Very true, a license is not issued on refrigeration experience although our license board asks questions on it. A lot of darn good men never handled refrigeration but the majority could be taught. Just for example. We now have a man with us who has a chief engineer's license and even he does funny things. He is deathly afraid of a ladder. We have a heavy permanent steel ladder leading to a small valve used in a line to admit live steam to the exhaust when the hot water load is heavy. He will not go up there and shut that valve but will pull down the cord leading to the outboard exhaust and blow live steam through to the outside all of his six hours. Should we put up with it? It costs money. He also sits and reads a lot and one morning he began to tell me about a book he was reading and then asked me to show him where certain pipe lines went. I did not. If he has time to read on the company time, he has time to look over the plant he is getting paid to operate. Who's next with criticism?

Robert Baker

Incompetent Chief Engineers

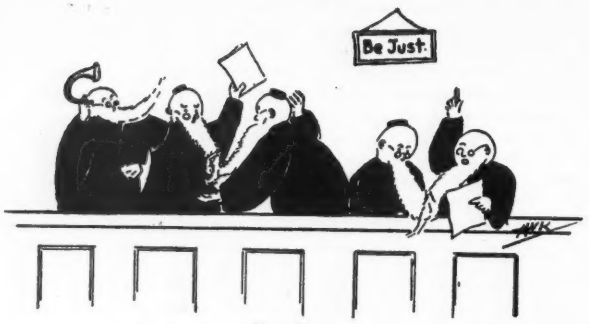
After reading the controversy about million dollar plants and $1500 men it seems to me that everybody is hedging about. What brings such things about? I started to work in a coal mine when 12 yr. old. This included all phases of coal mining. Later I went railroading, brakeman, fireman, machinist helper, hostler. Later sailor on the Lakes, have my A.B.'s. Worked in machine shops, did construction work, was a salesman, also a hobo. Then after all this mess, I started as a stationary fireman, took my examination and received my Engineer's license.

I am relating this more to indicate that I have a diversified opinion of things as others see them. Some people will say that a man is the best to his employer and employees because he eats and sleeps his particular job. Whatever it may be, I do not agree. A person like this gets a warped conception of everything around him; he starts going around in a circle, mentally. This attitude may have been right for Edison, Issac Newton, Galileo or Franklin for they were champions of one theory and had nothing else to contend with. But an engineer of today especially a chief engineer has a hundred and one things to think about and the more diversified his opinions are, the better he is for the job at hand. To further illustrate my point, show me a chief engineer that openly discusses all phases of the running of the plant with all of his men slighting no one and I will show you a modern plant with a harmonious group of men. Our present bad state of enlightenment among engineers is not the trouble nor can it be traced to unions or management. It is entirely the fault of the chief engineers of the last decade or more. How many operators had the experience of spending 5 or 10 yr in a plant and then knew less when they left this plant than when they were first hired. Why are chief engineers, and this holds true for many operating engineers, so reluctant to tell the other man something that will broaden his scope in the engineering field? I have often worked with such men. They would not tell the other fellow anything; in fact some of them just hope and pray that if you start something on your own initiative that the chief bawls the devil out of you or you break a leg or break what you are doing. This is purely because they have been so intimidated by these same chief engineers who would put Hitler to shame with their dictatorial powers that the men lose all sense of self-expression.

Management cannot be blamed either though in some cases it may be at fault. In many cases if an operating engineer expresses his opinion about something to the management and if he is caught doing so this man is invariably fired at the first opportunity the chief has of doing it. This may be right, after all the chief engineer should run the plant to his best judgment. You can't have everybody running it. Management is afraid of the chief engineer, so are the operators. Why should this paradox continue?

What is so glorified about a chief's job, that is, if you are a good one? I was one; I don't know if I was good or not, but I will say this, to be a good chief engineer a man must read his text books, subscribe to a good trade journal, and ask the opinion of his men about all phases of the operation of the plant. I don't care how smart or well versed the man is, he can't think of everything. One of these so-called smart engineers that I knew, kept trying time and again to keep a water level in a large boiler from going up, and in his efforts to do so he always set the regulating valve on the individual boiler, until a dumb fireman as he had called him, told him to check the pump governor and quit fooling around with the regulator. This of course was the proper thing to do, and it worked. Now, why do some of these men hold on with the grimness of death? Why won't they show their men any more than they positively have to and woe to the man that does anything first and asks permission later? I believe it is because their knowledge is so limited that it would not take even an ordinarily intelligent young man very long to know more than they did in a short time.

M. J. S.



How Would You Do It?

Problem 34. The Case of The Dirty Lanterns

FROM NOW ON, it is quite certain that Our Hero will stay out of root cellars; our Board of Judges will see to that. For the past two weeks the judges have had no respite from the subject of dirty lanterns; they have lived virtually in an atmosphere of dirty lanterns. Every letter they opened was about dirty lanterns, everybody they met brought up the subject. They talked dirty lanterns, read dirty lanterns, in fact they walked around carrying dirty lanterns in the manner of Diogenes, looking for some light on the subject.

The question, it may be recalled was, whether the dirty lanterns in Arthur Parker's root cellar gave out more heat than clean lanterns and thus were more effective in keeping Brother Parker's potatoes from freezing. He felt that the dirty lanterns radiated more heat—at least, he felt that dirty lanterns kept the potatoes from freezing better than did clean lanterns.

Despite its primitive character, the problem is an involved one. It is well known, of course, that clear glass transmits light better than it does heat. On a cold winter day, sunshine streaming through the glass panes of a green house will keep the interior of the greenhouse warm. The light rays pass through the glass with little effort and so heat the air and vegetation inside. The heat rays, however, cannot pass through the glass in the reverse direction and so the greenhouse heats up.

It will be obvious that in this example, all the energy represented by the heat in the greenhouse passes through the glass in the form of light. With this example in mind, it might be inferred that the same principle holds in the case of the lanterns. If the globe of the lantern is clean, it might seem reasonable to suppose that since clean glass transmits visible light so well, that all the light from the flame would pass through the glass and that this light would then be transformed to heat in the air and on the interior surfaces of the cellar and the objects it contained.

As far as the visible light is concerned this is true, all the light does pass through the glass of the lantern globe in this way and is later transformed into heat. The amount of energy represented by visible light in comparison with the total amount of energy released by the flame is very small, considerably less than one per cent. Even the best incandescent electric lamp is very inefficient as a producer of light and an oil lantern is even less efficient. Practically all of the energy released by the combustion of the volatile gases is released as heat—well over 99 per cent of it. Hence, it is evident that a clear globe will transmit very little of the heat produced by the flame and that most of this heat has to be dissipated by convection currents from the top of the chimney.

If the inside of the globe is coated with a layer of soot or dirt, however, this soot or dirt (soot particularly) will absorb a considerable amount of heat and this layer of soot is in intimate contact with the glass the temperature of the glass will rise above that of a clean globe, and no more heat will be radiated to the surrounding atmosphere.

This, simply is the explanation of the dirty lantern problem. As is pointed out by some of the contestants, the glass globe could be replaced by a metal stovepipe and the effectiveness of the lantern as a heater would, if anything, be increased, though it would shed no light.

Other factors also are involved, the radiation from the inside of the globe to the wick probably creates a higher ignition temperature and results in an increase in the consumption of oil. This will liberate more Btu's. With a greater rate of burning and higher temperatures, convection currents will be increased and this will cause greater effectiveness in the transference of heat.

The selection of the winning awards was not easy. Some of the solutions were in great detail, with numerical calculations, others presented excellent and detailed analyses of the action of an oil lantern. One's first impulse was to give the awards to those presenting numerical solutions, but after reading a number of these, it was felt that the first award should be given to the contestant submitting the simplest, straightforward explanation of the problem without the use of too many words.

Joseph Bressman's solution met these requirements more than any of the others, though many were exceedingly good. Consequently, the first award of the $25.00 War Bond went to Mr. Bressman. His explanation is clear, concise, and he takes into consideration all of the factors, conduction, connection, and radiation.

The second prize award proved more difficult, indeed it became necessary to make a duplicate 2nd prize award because there were two solutions that tied for this award. One of these went to Hollis J. Wyman of Auburndale, Mass., and the other to our old friend and consistent winner of prize awards in these contests, C. G. Clark of St. Johns, N. B. Mr. Clark's solution is particularly complete and his detailed calculations are very interesting. As he points out, in the extreme case of an opaque globe, the heat transfer from the globe by convection is 66 per cent greater than for a clean globe.

The other second prize solution, that of Mr. Wyman, is of especial interest because of the logical way in which he presents the arguments for the clean and dirty globes respectively.

The third prize award to Julian B. Calvert was made on the basis of his excellent analysis of the operation of an oil lantern and his comparison of such a lantern with a chain grate stoker. His diagram, Fig. 5 is reproduced exactly as he submitted it.

The prize winning letters follow:

FIRST PRIZE AWARD

Joseph R. Bressman
Cleveland, Ohio

A lantern will transmit heat to its surroundings through the mechanisms of radiation, convection and conduction.

The quantity of energy transferred from a luminous flame to an enclosing globe by radiation is a function of flame temperature, the globe temperature, the emissivity of the flame and the absorbtivity (assumed equal to the emissivity) of the globe. We shall now compare the quantities of heat transmitted by the dirty and the clean lanterns. It is assumed that the flame temperature in the case of both lamps remains essentially the same since it is a function of the air fuel ratio which will probably maintain itself constant. The emissivity or absorbtivity of candle soot which we shall assume coats the inside of the globe is 0.952 as compared with a value of 0.937 for smooth glass (Heat Transmission by W. H. McAdams, p. 394). Thus the dirty globe will absorb more heat from the flame and emit more to its surroundings than will the clean globe. Since more heat is absorbed by the dirty globe, its temperature will tend to rise above that of the clean globe, but, more heat will be radiated to its surround-

ings tending to cool it. A balance of this condition will result in an equilibrium temperature, which is probably slightly in excess of that of the clean globe. Thus, due to its increased emissivity and its higher equilibrium temperature the dirty globe will radiate more heat than will the clean one.

Now, in order that the flame may maintain itself in a condition in which more heat is removed than in the former state of equilibrium established with the clean globe, more heat must be supplied to the flame. This means burning more fuel. The lantern wick will remain saturated with fluid since the forces of capillarity remain constant in both cases. But, since the dirty globe radiates more heat to its surroundings, it will also radiate more to the wick and its metal holder. This will cause the vaporization of fuel at a greater rate which on burning will emit the increased quantity of heat that is necessary to restore the equilibrium upset by the increased quantity radiated by the dirty globe to its surroundings. In addition, the increase in fuel burned will increase the air necessary for combustion which in turn increases the heat transmitted by convection and conduction to the surroundings.

Thus through all three means, conduction, convection and radiation, more heat will be transmitted by a lantern with a dirty globe than with a clean globe and although the fuel supply will have to be replenished more often, in this case, the potatoes will be saved from freezing.

SECOND PRIZE AWARD

Hollis J. Wyman
Auburndale, Mass.

Heat energy may be transmitted in three ways.

1. Radiation
2. Conduction
3. Convection

RADIATION:

The transfer of heat by waves in the ether. This is the most efficient way of transmitting heat *in all directions.*

CONDUCTION:

The transfer of heat through a substance from molecule to molecule. Solids are the best heat conductors.

CONVECTION:

The transfer of heat by gas or liquid currents. These currents are caused by the increased buoyancy of heated and therefore expanded particles of gas or liquid.

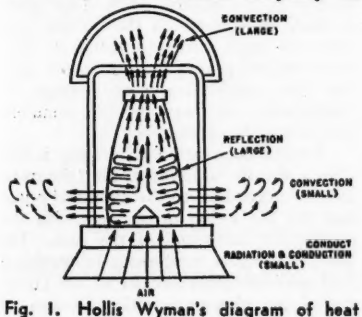


Fig. 1. Hollis Wyman's diagram of heat emission from a lantern with a clean globe

Dark substances absorb and radiate heat much more readily than light substances. If a flame radiates heat against a polished surface most of this heat will be reflected instead of absorbed and the subsequent radiation from the polished surface at its farther side will be small indeed. This is the case of the clean lantern globe.

Lampblack has the best of all surfaces for absorbing and radiating heat.

Some substances are good conductors of heat, some are poor conductors and some are insulators. Lampblack will conduct heat twenty times better than glass will.

Keeping the above information in mind let us take a look at the lanterns. The lantern flames are emitting radiant heat.

CASE 1. LANTERNS WITH CLEAN GLOBES.

The clean glass may absorb and radiate a small amount of heat to the vicinity of the potatoes.

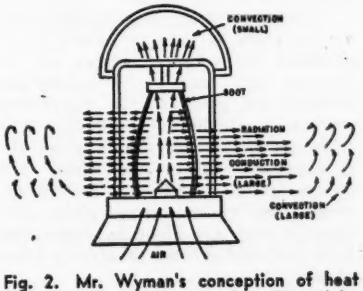


Fig. 2. Mr. Wyman's conception of heat emission from a lantern with a dirty globe

The clean glass will conduct some heat and set up convection currents in the air around the potatoes—perhaps the air will conduct some heat.

It seems to me that the largest amount of the heat emitted by the lantern flame will be reflected back from the clean glass and will go out the top of the globe by means of convection currents set up by the reflected heat. This heat will continue to rise to the top of the room away from the potatoes.

CASE 2. LANTERNS WITH DIRTY GLOBES.

The sooty layer on the glass will absorb the most of the heat coming from the flame and radiate it in all directions. The potatoes will receive the direct benefit of this heat.

The sooty layer will also conduct more heat than the clean glass could in Case 1 and this will stimulate conduction through the glass due to a higher temperature differential at the border-line of the soot and the glass. The convection currents set up by this conduction action will help heat the potatoes more than in Case 1 simply because the amount of heat convected will be greater.

The answer, no doubt, is in the comparative absorbent and radiating properties of the soot and glass coupled with the fact that for heat transmission in all directions radiation is the most efficient means.

I imagine that Mr. Arthur Parker of Peterborough, N. H. is a keen observer as well as a good engineer. I know now, why in the years gone by, I was able to keep milk from

Problem 35
The Case of the Hot Bearings

For once Our Hero is having enough troubles of his own to keep him from poking his nose into other people's business. Twice, during the last two months the bearings on a large grinding mill in the factory have burned out, each time with a considerable loss in production. The bearings of this mill, which is a high speed affair, are equipped with mercury thermometers and it is the duty of Our Hero's crew to inspect them periodically to prevent them from running too hot. Before the war, when help was plentiful, it was possible to make these inspections frequent enough so that any tendency for the bearings to heat up could be noticed in time and the load on the mill reduced. Now, however, he is short of help and the men cannot get around often enough to catch the trouble in time. So he is trying to devise some automatic arrangement which would signal the operators in the engine room. Normally the mill runs unattended and there is no attendant nearby. If this was your problem, what sort of an alarm arrangement or protective system would you devise? The bearings are ring oiled and the shaft is 6-in. in diameter. Would you use a mechanical or electrical arrangement or both? What sort of alarm equipment would be most suitable in your opinion?

Write out your opinion of this problem in a letter of not more than 1000 words, illustrated with diagrams if necessary, and send it to us. We will award a $25.00 War Bond for the best letter, and prizes of $10.00 and $5.00 respectively for the second and third best letters. The decision of the judges in this contest will be final.

Entries for this contest should be mailed not later than July 31, and should be marked, Problem 35. Address all letters to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago 4, Ill.

freezing in the old-fashioned milk wagons. We covered the milk cases with blankets after setting two or three lanterns on the bottom of the wagon. The lanterns were always sooty and the milk seldom froze.

DUPLICATE SECOND PRIZE AWARD

C. G. Clark
Saint John, N. B.

A detailed analysis of this problem requires the use of practically every type of heat transfer relation —combustion, radiation, reradiation, absorption, conduction, convection, and reflection—in various combinations. To answer the question definitely requires a numerical solution or at least a determination of the relative importance of each kind of heat transfer involved. Certain assumptions must be made which for the purpose of this discussion are as follows:

Surface area of lantern globe .....64 sq in
Oil burned per hr .....1/18 lb
Lb gas from combustion of 1 lb oil .....18 lb
Flame temperature .....2000 F
Room temperature ..... 40 F
Heating value of oil per lb.18,000 Btu

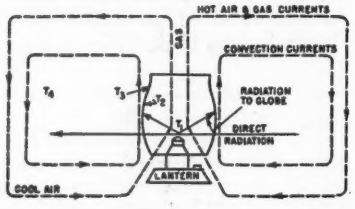


Fig. 3. Diagram for a clean globe, submitted by C. G. Clark. With opaque globe, direct radiation ceases, convection currents increase to give same total output. For globe condition between clean and opaque, convection currents vary in proportion

T_1 = Flame temp T_2 = Inside Globe temp
T_3 = Outside Globe temp T_4 = Room temp

Total Radiation from flame $= 0.173 \times$ Area, $\times \left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right]$

where A_1 = flame area sq ft and T_1 and T_2 are in deg, F Abs

Loss from outside globe surface $= (T_3 - T_4)$ $3.5 \times A_2$ where A_2 = globe surface area sq ft

Conduction through globe $= (T_2 - T_3)$ $A_2 \times U$ where U = heat transfer coefficient for glass and dirt

Heat Balance	Clean Globe	Opaque
1. Total Produced Btu per hr	1000	1000
2. Lost at top Btu per hr	470	470
3. Radiation-flame to outside	212	0
4. Radiation-flame to globe	318	530
T_1 (assumed) deg F	2000	2000
T_2 (calculated) deg F	269	approx 450
T_3 (calculated) deg F	244	381
T_4 (assumed) deg F	40	40
Flame area (for rad)	1.21 sq in.	1.21 sq in.

If the amount of oil burned per hour and the efficiency of combustion are constant regardless of globe cleanliness then the total heat output per lantern is fixed at 1000 Btu per hr.

The heat generated leaves the lantern by the globe or metal top as follows:

HEAT IN PRODUCTS OF COMBUSTION

For the assumed conditions this amounts to 470 Btu per hr. 0.24x1x (2000—40). This heat either directly or through contact with metal parts causes air currents to be set up as shown on the accompanying sketch. Since gas flow through the globe is streamlined convection currents to globe inside surface are not considered. Also since the radiation from a gas to a solid is less than 10 per cent of heat carried by the gas it is not considered in this approximate analysis. As the globe gets dirtier its inside temperature rises which affects flame temperature slightly but since this is less than 2 per cent it is also neglected. Thus for all practical purposes globe cleanliness will not affect this heat quantity.

RADIATION FROM FLAME

The balance of the heat generated or 530 Btu per hr leaves the flame zone in the form of radiant energy. The chemical and physical characteristics of the glass will determine its conduction and radiation transmitting properties and also to some extent its rate of fouling. With a clean globe of average glass about 40 per cent of the heat radiated from a kerosene flame will pass through unchanged. Normal pollution from the air reduces this value about 5 per cent for each side, that is, heat radiations passing are 38 and 36 per cent with one and two sides dirty respectively. With the globe opaque from lampblack or other accumulations no radiated heat passes through the glass.

For clean globe conditions 60 per cent of the heat radiated or 318 Btu per hr is absorbed by the glass, conducted to the outside as sensible heat, and dissipated by convection currents set up outside. The inside globe temperature will depend on heat transfer rates of the glass and dirt combination at any time. The outside temperature will be that required to liberate the heat received by conduction. Direct radiation from the globe outside surface to the surroundings will be very small and is neglected.

The effect of any dirt accumulation on the globe is thus to reduce direct radiation to the surroundings and to increase heat transfer by conduction through the glass to the convection currents established outside. The table shown on the sketch gives the approximate values for clean and opaque globe conditions. In the extreme case of an opaque globe heat transfer from the globe by convection is 66 per cent greater than for a clean globe.

Radiant heat energy direct from the flame to outside surroundings has to strike some solid object and be absorbed and transformed to sensible heat before it is effective. Apparently the convection currents are more effective than radiant heat in the case under discussion although this would depend on the materials in storage and the method of arrangement as affecting air circulation. The total heat released is constant, only the form of distribution being changed.

THIRD PRIZE AWARD

Julian P. Calvert
Flushing, New York

A discussion of this problem involves two different studies; combustion (liberation of heat by the burning of a fuel), and the methods of heat transfer (distribution by convection, radiation, and conduction).

The combustion action that takes place in the flame of this kerosene lantern is similar to the combustion of any fuel (gas, liquid, or solid) and is worthy of consideration, Fig. 4.

Kerosene wick burning lamps are equipped with a regulating screw by which the wick may be elevated or lowered thus governing the fuel feed for brightness by changing the exposed area of the wick (this case the heat release). The wick has a dual function; it acts as a fuel feed supply line and as a fuel bed. The quantity of the primary air supply is fixed by design of the wick cover shield that directs and protects the flame from abnormal drafts, Fig. 5. Observe that the resulting action of the flame makes it comparable to a combined forced draft and induced draft fan and that the speed of which is governed by the rate of combustion. The secondary air is unlimited as it is drawn with the primary air into the combustion zone through the perforated globe rack as required. The globe is bell shaped to reflect the radiant heat back into the combustion zone.

Acknowledgment of the presence of dirt either soot (unburned carbon particles) or dust (pulverized earth) on the inside of the globe indicates that the maximum heat is not liberated to the surrounding atmosphere (due to the insulating properties of the dirt) becomes concentrated and is carried away by the natural draft of the exhaust gases which is noticeable by an increase in temperature at the top of the lantern as the globe becomes fouled (dirty), which may lead one to believe that he is getting more heat from the lantern. Now if the globe is dirty or painted on the outside only with the inside surface maintained clean more radiant heat will be reflected back into the combustion zone, elevate its temperature, and may improve, minutely, the overall lamp efficiency.

Perfect combustion is burning a fuel with a specific amount of air (theoretical air) according to the chemical equation for the union of oxygen with the element or compound of the fuel. The practical (ideal) combustion is burning a fuel with the least amount of air (theoretical air plus excess air the sum of which is called the total air).

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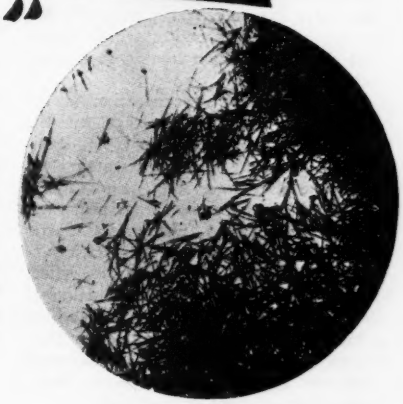

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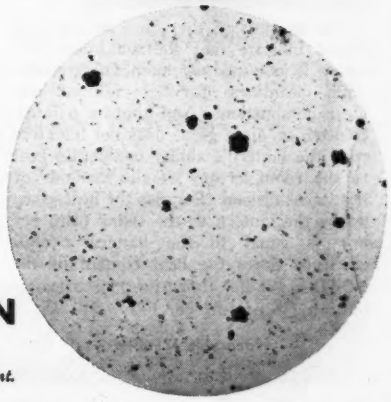

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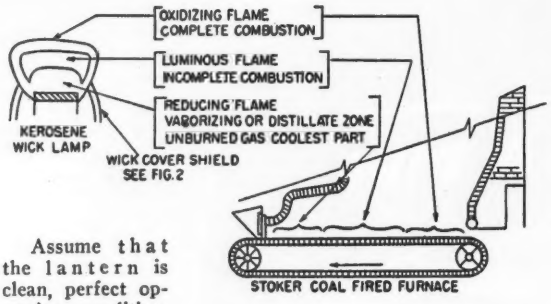


Fig. 4 (Above) Diagram submitted by Julian Calvert showing correlation of the 3 regions common to gas, oil, and soild fuel combustion zones

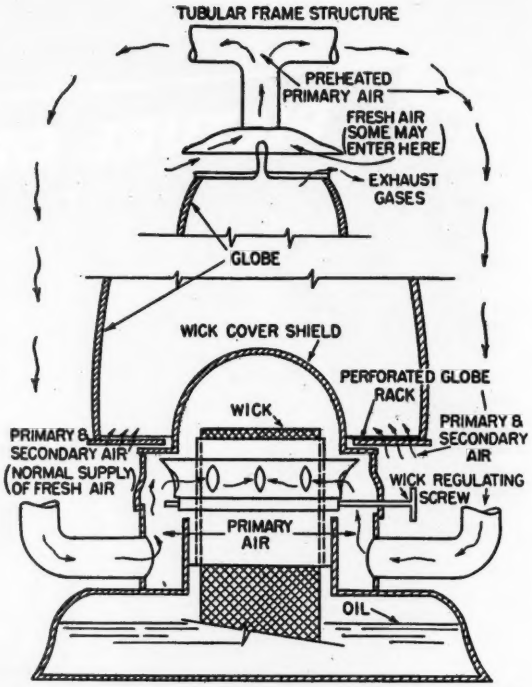
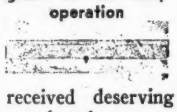


Fig. 5 (Right) Julian Calvert's diagram of oil lamp operation



Assume that the lantern is clean, perfect operating condition, filled with an ample supply of oil, and lighted. By manipulating the wick regulating screw the following conditions may be observed. On elevating the wick the flame will increase in length, turn yellow, and start smoking (evidence of deficient air supply and incomplete combustion). When the wick is lowered gradually the flame will decrease in length, stop smoking, and increase in light intensity (maximum brightness is point of ideal combustion). Lowering the wick further, correspondingly increasing the excess air, shortens the flame length and its intensity until it becomes cooled and is extinguished. The action of the flame for insufficient fuel supply or starvation is the same action as for increasing the excess air except in the final stage the wick will carbonize and burn. Then if the fuel supply is replenished and the lamp is again lit without cleaning the wick (removing the unburned carbon) the effect is equivalent to a dirty fuel bed and the flame will have a tendency to smoke due to incomplete combustion which means that the gases contain some carbon monoxide.

Heat transfer by convection is the process of transporting heat by the natural movement (difference in densities) of hot fluids (gas, air, water, etc.) from one place to another. Radiation is the process of transporting heat and light by ether waves (phenomenal elastic fluid that occupies all space). Dark surfaces absorb and bright surfaces reflect the radiant heat waves. Conduction is the process of transporting heat within a material without movement other than expansion and contraction (phenomenal vibration of sympathic adjacent molecules of an element or material).

An analysis of the above information should indicate that the maximum efficiency is obtained by maintaining maximum cleanliness for best ignition and ideal combustion. And that a painted, colored, or dirty globe does not interfere with the lantern's ability to liberate heat to the room by any of the methods of heat transmission. Because the heat given up by the lantern to the cellar (Btu per hr) is equal to the lantern overall efficiency times the heat content of the oil (Btu per lb) times the rate of combustion (lb of fuel per hr).

Honorable Mention

Among the many splendid solutions received deserving honorable mention, one that deserves especial mention is the one submitted by Jesse L. Erisman, of St. Louis, Mo., who incidentally received the first prize award in the "How Would You Do It?" contest in the May issue. Mr. Erisman gives a very clear cut analysis of the problem and his letter should be of interest to all who have been following this problem. As he points out, the superior radiating and absorbing power of dull, black, and roughened surfaces has been proved many times and of course, this is an important aspect of this problem. He refers to the Stefan Boltzmann formula for his supporting data on the mechanism of radiant transmission. Pure lampblack, he says, is considered the nearest approach to a perfect black body and Clark's table from Kent's handbook gives it a radiation and absorption factor of 100 per cent as compared to 90 per cent for ordinary glass. Glass is given a reflecting power of 10 per cent compared to zero for lampblack.

Blondes vs Brunettes in Moonlight

R. A. Roulston of Lawrence, Mass., goes somewhat beyond the confines of the problem to philosphize on the relative warmness of women's hearts in the moonlight. Since he provides no supporting data, we must assume that he speaks from experience. This is a most intriguing aspect of the problem and worthy of further research but we feel it should include red heads as well.

"T'is true, t'is true! Methinks that the dirty lantern will give out more heat than a clean lantern of the same size and burning with the same flame" says Mr. Roulston. Did you ever look into an optician's window and see that little instrument with four delicately balanced vanes rotating within a glass bulb?

"And, if you saw it, did you notice that one side of each vane was polished and the other side of the same vane was black? That little device is known as a radiometer and when radiant energy from the sun, a candle flame, or other light source strikes upon the polished surface of those vanes it is reflected, and when the same energy strikes against the black vanes, the energy is absorbed and the vanes become hotter. As the molecules of air in that bulb bounce around, those of them that strike the hot blackened surfaces will rebound with increased velocities and cause the vanes to rotate on their pivots. From the physicists we learn that a black body while being an excellent absorber of radiant energy, is also an excellent radiator of radiant energy. In the case of Brother Parker's dirty lanterns, we have an instance of the blackened ones absorbing more radiant energy, and consequently radiating more radiant energy in the form of heat to the surroundings, to wit, his root cellar. The clean lanterns allow the energy to be transmitted through the clean glass in the form of light instead of absorbing the same radiant energy in the form of heat and then liberating it.

"This fact has been proven in many ways; a light colored car parked beside a black car will feel much cooler to the hand than the surface of the black car, assuming that both are parked in the sun. A woman in a white dress will be cooler on a hot day out of doors than her sister in a black or dark dress; and a brunette in the moonlight will have a warmer heart than a blonde under the same conditions."

To be continued in August issue

INTERCHANGEABILITY *Speeds* Maintenance

THE wide interchangeability of parts designed into "Renewo" and "Ferrenewo" valves has long proved a boon to maintenance men in making their job easier.

Since valves control the very life lines of productive processes—steam, air, water, oil, gas and other fluids—it follows that every precaution be taken to insure proper functioning.

Regular checking and inspection, and prompt servicing when necessary, will be repaid in more efficient performance and longer valve life, and may well prevent possible shut-down of equipment for more costly repairs later.

The simplicity of design of Lunkenheimer "Renewo" and "Ferrenewo" valves, with interchangeable parts, makes it easy to keep them in good operating condition with minimum expenditure for maintenance.

Lunkenheimer distributors are located in all industrial centers.
Use the facilities of the one nearest you for service on your requirements.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO, U.S.A.
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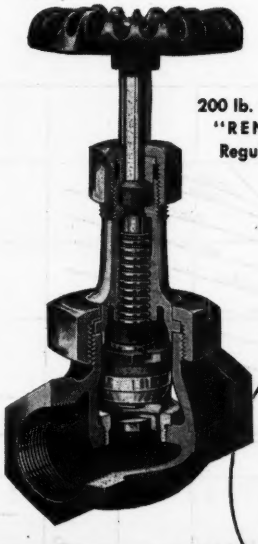
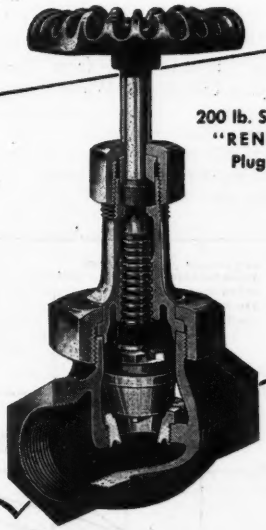
EXPORT DEPT., 318-322 HUDSON ST., NEW YORK 13, N. Y.

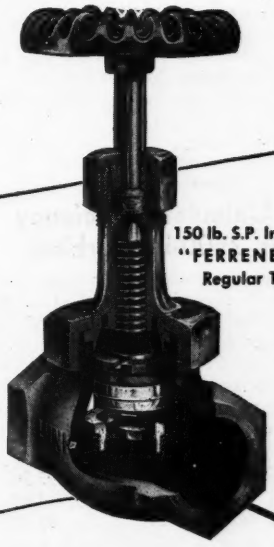
SIMPLICITY OF DESIGN
MEANS
EASIER MAINTENANCE



200 lb. S.P. Bronze
"RENEWO"
Regular Type



200 lb. S.P. Bronze
"RENEWO"
Plug Type



150 lb. S.P. Iron Body
"FERRENEWO"
Regular Type

Here's how Interchangeability Speeds Maintenance . . . . . .

All parts of the valves above (except bodies and bonnet rings) fit each other perfectly. If, for example, you need a stem, disc or seat ring for the "Renewo" you can use the corresponding part of the "Ferrenewo", *it is exactly the same.* This means fewer parts to be carried, speedier repairs and greater ease in making them.

LUNKENHEIMER VALVES

Questions And Answers

Question No. 265

What Is Eating Up the Fusible Plugs?

IN OUR PLANT we have three 72 in. by 18 ft. hrt boilers of the dry sheet type. From 1939 to 1943 I retubed all these boilers. This year, on inspecting these boilers, we found that in two of them the fusible plugs were half eaten away from the inside and the plug on the third boiler was well started. The insurance inspector states that this is caused by electrolysis or battery action. The boilers are very clean inside and out.

What causes this electrolysis or battery action in boilers of this type?

I have seen the same thing happen in Scotch Marine boilers on board ship, where boiler feedwater from salt-water evaporators was used. There we had to hang zinc plates on the stays so the electrolytic action would eat up the zinc instead of the boiler metal.

Any information on this subject will be greatly appreciated.

Lee, Massachusetts. M. G.

Question No. 266

How Calculate Efficiency of this 2500-kw Turbine

THERE HAS BEEN some debate at our plant as to the correct method of determing the thermal efficiency of our multi-stage condensing extraction type turbine. It drives a 3125-kva, 2500-kw 0.8-pf, 3-phase, 60-cycle, 13,800-v, 3600-rpm alternating current generator with 125-v direct-connected exciter. Rated efficiency of generator

At full load	95.5%
At ¾ load	94.8%
At ½ load	93.3%

This unit is one of two turbine generators that run mainly to supply heating and process steam, most of our required electric power being purchased.

Steam is extracted from the above unit at 43 psi gage and is fed to the plant for heating and process. There is a 5 psi gage line supplying the feedwater heater.

Various steam flows and temperatures and other data necessary for calculating efficiency are given in the attached tabulations. Also shown are the manufacturer's curves of water rate and steam extraction.

I would like to know, in particular, the correct method for determining the thermal efficiency and the amount of steam that can be charged to electricity. This involves correcting the water rate to the actual back pressure and correcting the throttle flow.

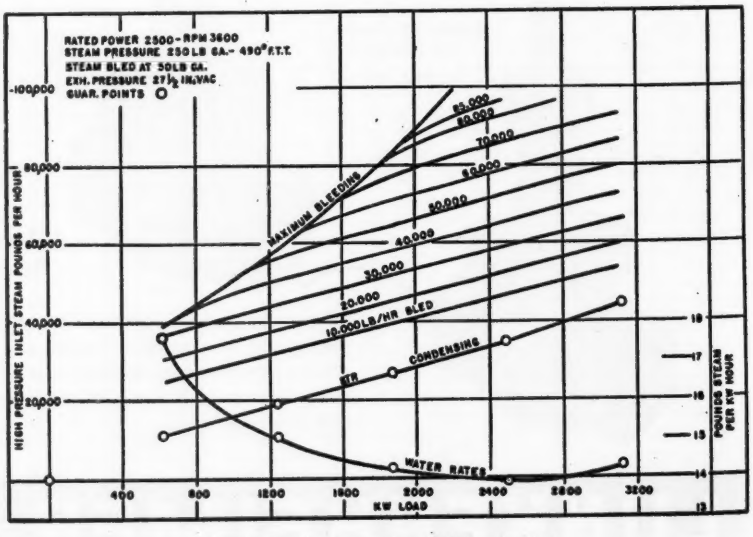
From the curves, water or steam rate for the rated power output of 2500 kw is 13.8 lb per kwhr. Our average monthly load on this turbine has been from 1850 to 2100 kw, which have steam ratios of 14.35 and 14.00 lb per kwhr respectively, from the guarantee curve, which is for 27.5 in vacuum or 1.5 in back pressure averaging, for this month, 1.35 in., Hg. From the Rankine engine principle, the per cent reduction in steam rate is about 4 per cent.

The original set-up for determining efficiency was not in very good shape when I received it. I have to compute it monthly. I would appreciate your computing the actual efficiency of the turbine and the overall engine efficiency and defining their meaning in this case. A temperature-entropy or total-heat entropy diagram would help me in understanding the situation.

Ann Arbor, Michigan R. B. M.

Data on R. B. M.'s 2500 kw—Condensing Extraction Turbine.

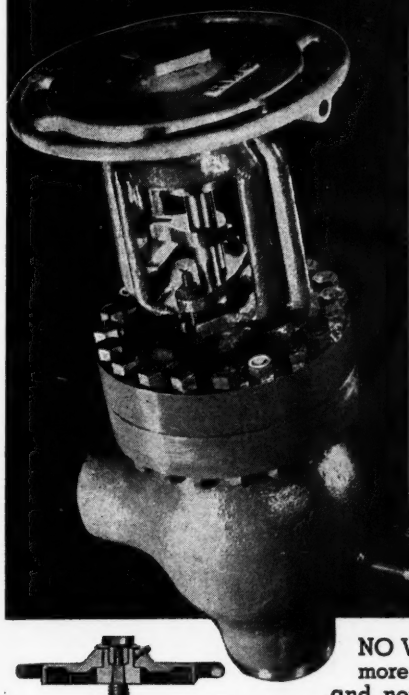
Electricity Generated	1,250,200 kwhr
Throttle	
Flow	54,116,000 lb per month
Pressure and Temperature	216 psi gage 450 F
Heat (231 psi abs, 450 F)	1,236.3 Btu per lb
Extraction	
Flow	42,338,000 lb per month
Pressure and Temperature	43 psi gage 290 F
Heat (58 psi abs, 290 F)	1,176.9 Btu per lb
Average Back Pressure	0.7 in. Hg
Condensate, by Steam Table	69 F
Actual by Thermometer	77 F
Hours Unit on Line	665 hr
Average kw load $\frac{1,250,200}{665}$ =	1880 kw
Average Extraction Flow $\frac{42,338,000}{665}$	63,700 lb per hr (Meter)
Average Throttle Flow $\frac{54,116,000}{665}$	81,300 lb per hr (Meter)
Average Throttle Flow from Curves	73,000 lb per hr
Condenser Circulating Water Temp.	54 F In 60 F Out
Feedwater Temperatures	
Plant Return	158 F
Leaving Feedwater Heater	227 F
Make-up	53 F



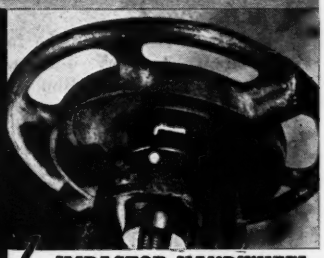
Manufacturer's curves for 2500-kw turbine referred to by R.B.M. in Question No. 266.

NUMBER THREE OF A SERIES ON VALVE SELECTION

Here's how to buy a Non-Return VALVE

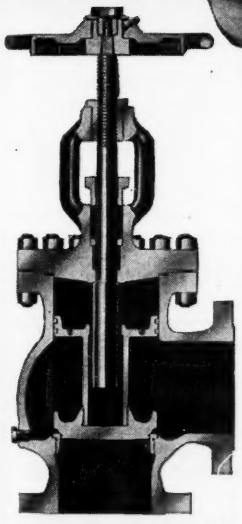


DO YOUR *Non-Return* VALVES have these 5 features?



1 IMPACTOR HANDWHEEL

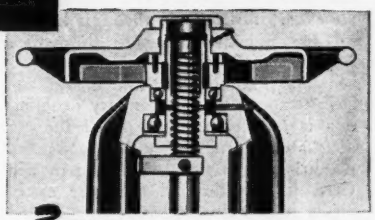
2 HOUR GLASS DISK-PISTON



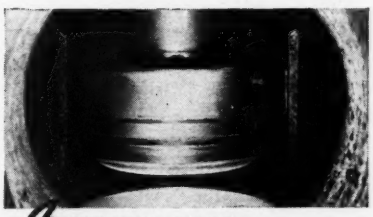
It pays to specify Edward non-returns for all steam pressure installations, from 150 lb upward. The valve above, rated at 300 lb, has all the desirable Edward design features that mean low cost operation at any pressure.

NO VALVES in the boiler plant are more important than non-return valves and none deserve more careful study before purchase. Here are five important features to look for in selecting non-return valves . . .

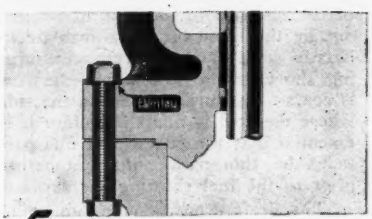
1. The most effective means for closing a valve against high boiler pressures is the Edward patented Impactor handwheel. A turn of the wheel exerts sledge hammer blows against the stem cross arm, giving maximum closing torque in minimum space.
2. Edward hour glass disk-piston gives maximum flow area without sacrifice of operating dependability. Piston rings are heat treated and hardened EValloy stainless steel.
3. Companion to the Impactor handwheel in larger valves, the Edward patented EValthrust yoke bushing sets new standards for easy operation. Double combination angular-radial ball bearings greatly facilitate tight valve closing.
4. Guiding is extremely important. Disks in Edward non-return valves are positively guided, without danger of hanging up, through three integrally cast and cored-out tear-drop design guide ribs and Edward seat guide lip.
5. Newest plus-value feature in Edward top temperature non-return valve construction is EVinlay facing for bonnet nut surfaces to end possibility of nuts seizing or galling on bonnet flange. Also applied to stem bearing surfaces.



3 EVALTHRUST YOKE



4 GUIDE RIBS



5 EVINLAY FACING

Edward non-return valves are built in all sizes with either flanged or welding ends for pressures from 150 to 2500 lb sp.

THE EDWARD VALVE & MFG. CO., INC. • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

Answer No. 248

How Can Boiler Operation Be Improved?

We ARE SUPPLIED with the following information: 2 B&W 4-drum, bent-tube boilers rated at 600 Bhp, operating at 135 psi steam pressure, no superheaters, economizers, or preheaters. The boilers are fired with Northern-Illinois wash nut 1 in. by ¼ in., on forced-draft chain grate stokers with a fuel bed thickness between 4 in. and 6 in. depending on load, flue gas temperature 460 to 700 F (Ave. 560 F), CO_2 varies between 6 and 8 per cent (Ave. 9 per cent by recorder), and a diagrammatic plan view shows how fire burns "V-shape" on the chain grates.

Data from Julian Calvert

(A) "Shouldn't I be getting a lower flue gas temperature and a higher CO_2?" There is a definite relationship between the saturated steam temperature and the exit gas temperature for this type of boiler that may be used as a guide for proper operation. On this basis it may be assumed that the exit flue gas temperature is approximately 100 F higher than it should be if the fuel bed was properly maintained.

With the plan view of the fuel bed in mind the assumptions may be further substantiated by this reasoning. On the consumed side of the fuel bed there is an excess flow of air through it while on the unconsumed side there is a deficiency of air which results in secondary combustion and a high exit gas temperature. Secondary combustion is the delayed burning of the coal distillates. Referring to the above explanation and the given 9 per cent CO_2, it is estimated that the excess air is approximately 100 per cent. If the gas dilution is further increased the CO_2 will correspondingly decrease in per cent.

(B) "What is the cause of the 'V-shaped' burning and how can it be remedied?" The "V-shape" burning of the coal on the chain grate stoker indicates that the flow of air through the grates and the fuel bed, for a given section across it, is not equally distributed. If the coal particles are coarse on one side of the fuel bed and fine on the other side the resistance of the fuel bed to the flow of air will not be the same for a uniform thickness of coal, which will result in burning short on the side where the coal is coarse and burning long on the side where the coal is fine. Therefore it is essential that the coarse and fine particles be thoroughly mixed together prior to the fuel entering the furnace.

The draft drop through the boiler is fixed by design. So when operating with the design furnace draft, an even fire, and a uniform fuel bed the fuel bed thickness and stoker speed may be established for any load with this fuel. It will be noted that for each load the thickness of the fuel bed will change and the furnace draft will vary correspondingly. The maximum CO_2 without the presence of CO will indicate the best combustion that can be obtained with this particular fuel. Varying loads can be carried by proper regulation of the thickness of the fuel bed and speed of the grate. Of course, a change of fuel in grade and size will require another practical study to establish the above conditions.

Recommend that tests be run at each probable expected load, in accordance with ASME code, to determine proper coal feed and stoker speeds and that the following be noted: efficiency, satisfactory fuel bed for minimum steaming rate, and responsiveness to sudden demand.

(C) "Would you recommend asbestos covering for the 16 drum heads on these boilers?" The most common insulation for this type of job is 2 in. 85 per cent magnesia plus ¼ in. asbestos cement plus ¼ in. asbestos and Portland cement. The heating loss from the bare surface is 870.0 Btu per sq ft per hr compared to 48.3 Btu per sq ft per hr through the insulation which means a saving of 821.7 Btu per sq ft per hr if insulated.

Assume that the average area of a drum head (less area of manhole cover which is always left exposed) is approximately 8 sq ft and there are 16 such heads to be covered. And that the heat content of the coal is 12,650 Btu per lb. Then

$$\frac{\text{Btu per sq ft per hr} \times \text{area per drum} \times \text{no. of drums}}{\text{Btu per lb coal} \times \text{Blr. Eff.}} = \text{lb coal/hr saving}$$

$$\frac{821.7 \times 8 \times 16}{12{,}650 \times 0.70} = 11.88$$

Insurance, ASME, and the manufacturer's markings as are located on the drum near the manhole must be left exposed.

Exposed heating surface is a hazard.

Flushing, N. Y. JULIAN P. CALVERT

Pointers on CO_2, Air Supply, etc., from Martin

(A)—J. S. R. should remove the filter on the flue gas sampling pipe, of his CO_2 recorder, because it may be plugged up with soot. If it is plugged up and after he replaces it clean, and he does not get the proper reading, he should look to the CO_2 analyzer itself. If he is in doubt as to the potash solution mixture, he should get in touch with the maker of the instrument.

I remember one case in which the sight glass on the CO_2 analyzer in which the solution is actuated by means of an inflated rubber bladder was cracked, hence we lost a little of our solution every day. Instead of getting a CO_2 reading between 12 and 13 per cent, the recorder started to show 10, 9, 8, 7, per cent. The fireman was trying to keep the CO_2 reading high. Looking into the boiler setting through the peep hole, I noticed that the furnace flame and surrounding brickwork were actually white. Then, looking higher, I saw the refractory material dripping down like icicles. Well, we all jumped around then like Superman and proceeded to bring the furnace temperature down to proper operating level. After the new glass was installed and the proper potash solution added to the apparatus, we had no more trouble with the CO_2 readings.

Sometimes a wrong CO_2 reading will be obtained if the baffles are "gone"; that is, if any major holes develop in the baffles or setting, which cause the hot gases to short circuit themselves. Another reason for wrong CO_2 readings is the placing of the sampling pipe in the wrong part of the setting. And as a last resort, the meter recorder should be calibrated against the reading of a portable meter, etc.

(B)—I would have to see the boiler installation (boilers) before I could determine the cause of the V-shaped burning of the fire. I remember one case where the firemen used to set the "gate" for the coal bed thickness, and nine times out of ten one end of the gate would be higher than the other. Each end of the gate had a hand adjusting wheel for raising or lowering the gate. Some of the firemen would check back on the adjustments, others would not.

Many times the fireman would be attending to other related duties in the plant and upon coming back he would find that half or more of his coal feed at the gate had stopped. He would then fly like Superman for a piece of flat iron with an off-set hook on the end of it, with which to poke and hammer at the coal in the hopper.

The wall separating one boiler from the other will carry a higher ignition temperature, because the heat is transmitted through the wall from each side; that is, heat is transmitted back and forth to such a degree that special bricks have to be used in this wall to keep the whole wall from collapsing. Consequently the coal nearest to this center wall will burn faster than at the outer wall, which is cooled by the air temperature in the room.

As most engineers know, chain grates are used to burn coal that has a high ash content. Sometimes this ash accumulates by fusing itself onto the grates and plugging up the air holes, so that the draft is diverted around the fuel bed and, as a result, the grates are burned away. This will cause the fire bed to burn unevenly and there is a waste of fuel.

(C)—This is a peculiar question, but a good one. I do not recall if the ASME has any definite ruling on this subject or whether there are any State laws that govern the insulation of boiler drum heads.

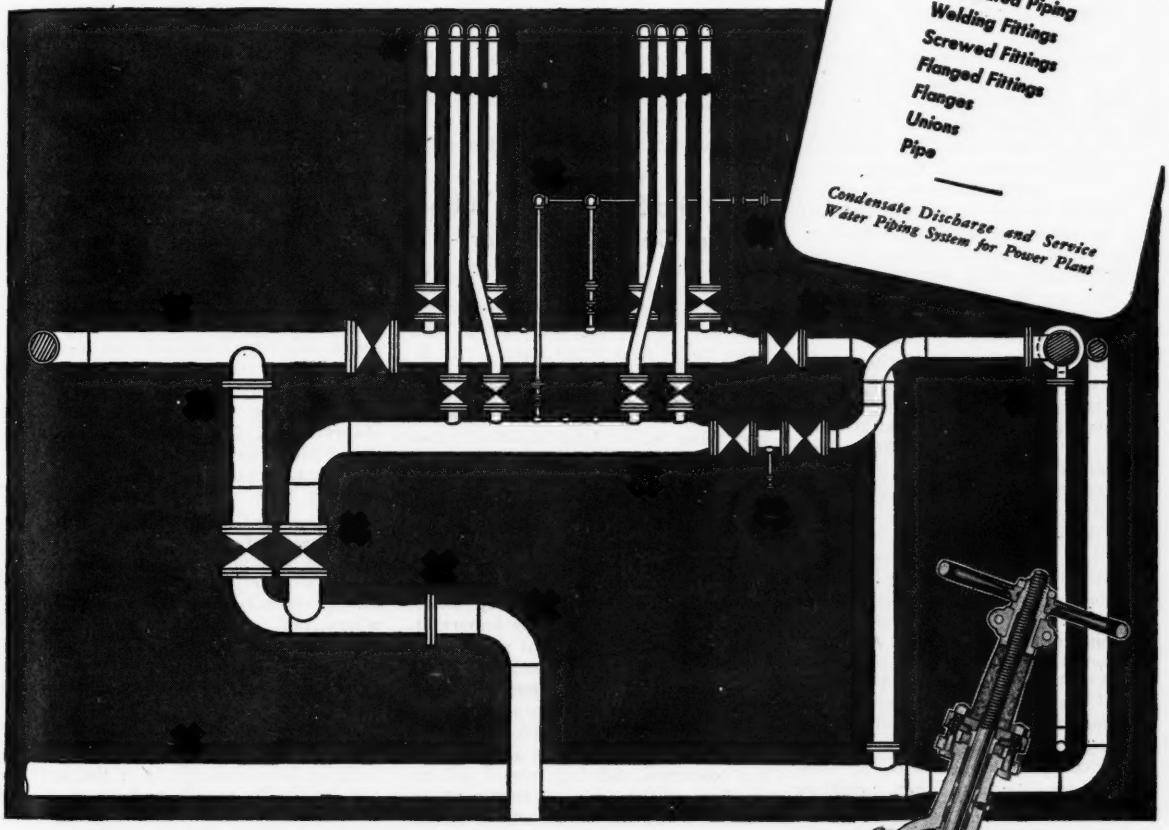
Sometime ago a boiler inspector wanted us to remove boiler brickwork formed around the end of a drum head so that he could inspect the rivets. The chief told him it wasn't necessary and we never do such a thing, unless the boiler is an old one and falling apart.

Piping systems...any kind...for any service CRANE equips them fully

ONE SOURCE OF SUPPLY... ONE RESPONSIBILITY FOR ALL MATERIALS

No matter what your needs in piping equipment—whether for power or processing systems—all the benefits of single source supply can be yours. Pipe, fabricated piping, valves, fittings—all these essential materials down to the last accessory are available from Crane. You choose exactly what you need—from the world's largest selection for all pressure-temperature classes.

Ordering—keeping of parts stocks—maintenance—such operations are simplified if you Crane equip. More important, one responsibility for quality and craftsmanship of piping materials is a primary aid to good installation. Crane meets that responsibility with a record of 89 years' leadership in the piping equipment field. CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.



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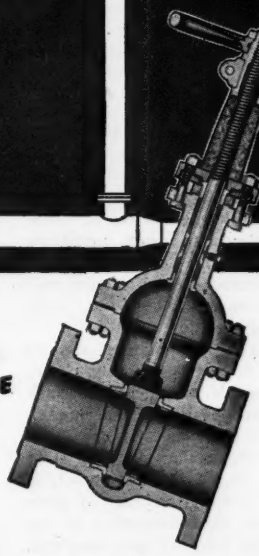
Equipping completely with Crane materials insures one high standard of quality in every part of piping systems. That dependable quality is exemplified in Crane Steel Gate Valves: Finest flow behavior results from their straight-through ports. Severest line stresses are overcome with rugged bodies. Smooth operation is maintained by a ball-joint type stuffing box gland, strong tee-head disc-stem connection, and ample stem bearings. Positive seating is aided by extra long guide ribs.



CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

As to covering these drum heads, I suggest J. S. R. cover them. If he is interested in how many Btu's he can harness, I suggest he consult his handbook for heat losses from bare metal. For the lower drum it will be slightly less, but he shouldn't get grey hair over it.

Fairview, N. J. MARTIN N. GOZDENOVICH

Septor Says Correct Air Leakage and Distribution

(A)—First, J. S. R. should get that CO_2 recorder, or recorders (he should have one for each boiler), working properly and recording correctly, and check at least once a week to see that it stays that way. Examine all brick work of the boiler setting, repair all cracks and plug all holes that may allow air infiltration, check gas sampling line for leaks. The gas sample should be taken from within the boiler setting, preferably in the last pass, and not in the breeching.

(B)—The fuel bed burning short on one side is probably the greatest contributing factor to the low CO_2 of the flue gas. This may be caused by uneven depth of the fuel bed. Check distribution rate to be sure that it is spreading coal at an equal depth across the grates.

Uneven burning of the fuel bed may also be caused by uneven air pressure. Clean air boxes of all siftings and ash, check air gates to be sure the openings are even, or they may have to be set to open slightly more on the side that does not burn out.

Not knowing all the operating conditions, to suggest operation at a certain flue gas analysis is more or less a guess. However, if J. S. R. will shoot at about 12 or 13 per cent CO_2 I don't think he will be far wrong. To go higher may result in a considerable loss of combustible in the ash, and to go lower would increase the stack loss.

(C)—I can think of no reason why the drum heads should not be insulated; it certainly would prevent heat loss.

South Amboy, N. J. RAYMOND SEPTOR

Borchelt Also Feels It's Incorrect Air Distribution

(A) and (B)—J. S. R. HAS brought up old questions when he mentions CO_2 and flue gas temperatures. I think one can say there is always room for improvement on either, or both, of these figures, for constant firing conditions are hard to maintain. The older a boiler and its appurtenances get, the more vulnerable the furnace becomes to air leaks and mechanical troubles.

The CO_2 and flue gas temperature readings may be improved in any, or all, of several possible ways. High stack temperatures are a sign of too high a velocity of the products of combustion, not allowing the boiler surfaces sufficient time to absorb the heat available in the gases. The high velocity of gases may also mean the combustion is not complete at the point of gas sampling; thus, a low CO_2 reading.

The 4-in. to 6-in. fuel bed may be too thin for the drafts used in this particular case. The stack effect plus the forced draft may be causing blow holes in this thin fuel bed, which will increase excess air and decrease CO_2. I believe the CO_2 and flue gas temperature may be improved by sealing up any leaks in the smoke passages and by correcting uneven fuel bed thickness through which excess air passes.

It may prove worth while to experiment with a heavier fuel bed—say 8 or 10 in. The unbalanced distribution of coal on the grates may be uneven burning due to improper distribution or maladjustment of the adjustment plate that controls the thickness of the fuel admitted from the stoker hopper. Segregation of the coal as it enters the hopper may affect the distribution somewhat.

Zoning in the wind box may be the cause of too much air at the points where the fire burns out the quickest. Even wind box pressure throughout will help to keep the fuel burning uniformly across the stoker. This may mean minor damper changes under the grates.

(C)—Insulation of the boiler drums will be a heat-saving step. J. S. R.'s drum ends were probably overlooked by the insulating men.

Aberdeen, Miss. W. C. BORCHELT

Answer No. 249

Why Did Slag Screen Tubes Fail in Only One Boiler?

HE HAS two Stirling 4-drum type boilers, operating at 180 per cent rating, steam pressure 245 psi, steam temperature 520 F, and supplied by the same boiler feed pump, said T. E. H. in the February issue. One of the boilers had a screen tube failure. It was repaired, cleaned, restored to service, and three weeks later identical tubes ruptured again. A chalky scale was observed in the ruptured tubes that ranged in thickness from 1/64 to 1/16 in.

Trouble May Originate in Water Treatment

NOTHING was mentioned in the question in regard to the firing conditions of the boiler which is important. Because if the furnace heat release was not equally distributed, localized areas of tubes would absorb more heat than they were able to conduct away, which is equivalent to a tremendous increase in boiler rating in so far as the tubes are concerned, and they would fail regardless of the chemical treatment. A careful study of the log book for an intermittent complete Orsat analysis or some check of the combustion should be considered.

Assuming that the above was not the case, then the tube failures are directly attributed to improper care in chemically treating the boilers. This statement is substantiated by the number of service hours and the presence of the 1/16-in. scale in the ruptured tubes.

Boilers are treated internally with chemicals for a specific type of raw water to prevent the solids from forming a hard scale on the boiler internal surfaces and to retain them in a suspended coagulated state (soft sludge or mud) that are disposed of by blowing down the boiler when the concentrations become too high.

The problem of determining the kind of scale that will be produced from a raw water analysis is a very difficult job and requires the services of an experienced chemist to establish a satisfactory treatment. There are numerous combinations of salts and all react differently in various types of boilers, pressures, concentrations, and ratings. However, once a proven treatment is established the boiler internal conditions can be progressively observed. And if these concentrations are maintained by analysis of periodic representative boiler water samples the solids will remain nonadherent to the metal surfaces.

It is believed that the treatment is introduced in the system before the boiler feed pump and that the feedwater piping is of a design that does not give equal distribution of the chemicals to both boilers. Also that the boilers are blown down according to a fixed schedule and not according to their water concentrations, which further reduces the ability of the chemicals to do a thorough job. Under-treatment is worse than over-treatment. The chances are that one boiler is overtreated while the other is under-treated and this one is giving all the trouble.

I recommend that a complete investigation be made of the entire system from the raw water to boiler water concentrations of each boiler. And during this time I suggest that thermocouples be installed on the screen tubes at points of previous failures that tube metal surface temperatures may be observed and the boiler capacity reduced when they get too high, thereby preventing a failure.

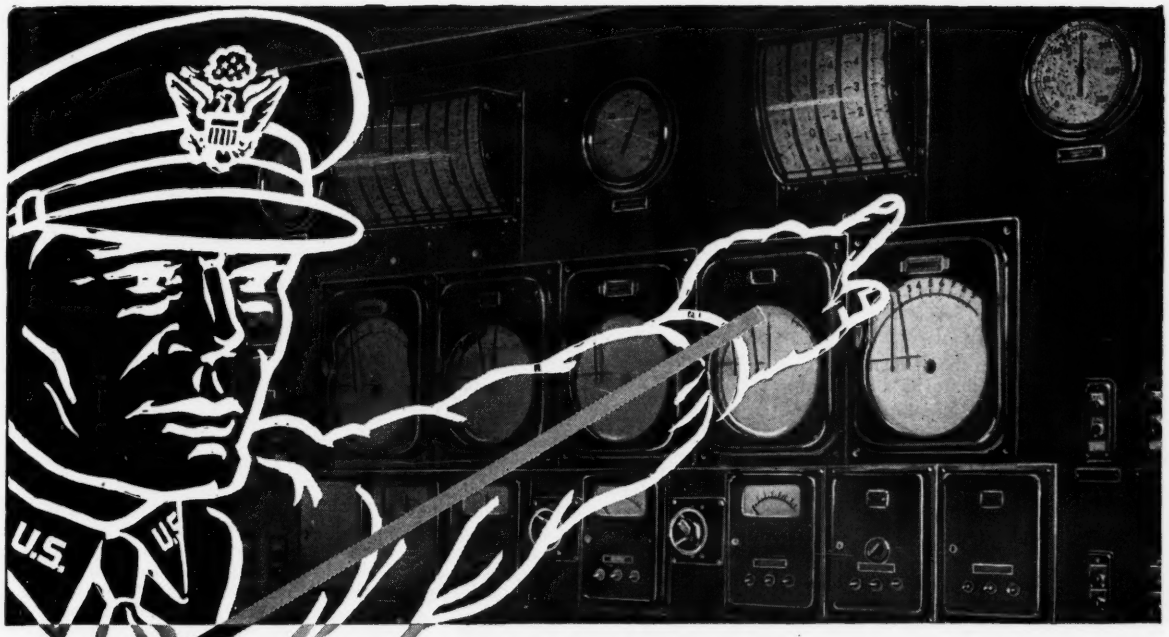
Flushing, N. Y. JULIAN P. CALVERT

Look at Furnace Conditions and Water Treatment

SCALE 1/16 or even 1/64 in. thick, of the hard variety, will result in burned tubes, especially if the tubes are located where the gas temperature is high, such as tubes facing flames. The fact that another boiler using the same feedwater and operating under similar conditions did not have any tube failure is explained by the fact that at critical conditions it takes very little difference to bring about failure. It is the straw that breaks the camel's back.

The boiler where the tubes failed might have been operating at a higher load, either due to error in the flow meters or the average load might be the same but one boiler might have a more uniform load while the other may have peaks much higher than average. If these boilers are gas, oil or pulverized-coal fired, flame impingement might be slightly different in one than in the other, due to original construction or slag formation later.

If hard scale of 1/16 in. or even 1/64 in. accumulated in a matter of a few months, the water conditioning should be looked after. Pretreatment of boiler water cannot be entirely satisfactory, no matter how perfectly it is done. In addition, internal treatment



USE THIS WINNING STRATEGY ON YOUR BOILER PLANT

Fuel-Saving Starts With CONTROL

THOSE perpetual foes of combustion efficiency—Excess Air, Fuel waste, High Operating Cost—haven't a chance against the strategy of Hays Automatic Combustion Control.

There's no guessing here, nothing left to chance. Your Hays Control System assembles *all* the data concerning combustion, measures all variable elements, and *regulates* them—automatically. It does that job better than man-power can do it—never absent, never overworked, never an unwary instant: smooth, faultless, *tireless* efficiency 24 hours every day.

Hays Combustion Control's greater service today is in putting youthful efficiency back into wasteful steam plants—making them *better* plants, safer plants, lower cost plants.

Smart strategy?—it never misses. The Hays Combustion Control Catalog explains how you can use it. Full of helpful steam-power data. Write for it today.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, IND.

must be used, in the form of phosphate, for instance. There should be maintained at all times a residual of 30 ppm of phosphate in the boiler water.

The concentration of the boiler water should also be kept under control. Since the loss due to blowdown is small, there is seldom any justification why the concentration should be over 3000 ppm in any case and even 1000 ppm in some cases might be justifiable.

Oak Ridge, Tenn. N. T. PEF

The Scale Is the Cause, Says Martin

T. E. H. will find that the tube failure was caused by the cementation of either calcium sulphate or silica with other insoluble matter in the boiler water. This type of scale has a strong tendency to crystallize and precipitate, and to form a hard scale, which is often difficult to remove; especially if tubes are of the bent type, and scale formations are hard to detect. Scale thus formed has a poor heat conductivity, and therefore, causes overheating and failure of the boiler tubes. Silica has less tendency to form scale on the hottest tubes than calcium.

Tube failures will occur if slag deposits adhere to the tube surfaces—although the experts today have not as yet reached a definite conclusion as to what makes the sweeping gases thin the outer surface of the tubes, causing tubes to rupture. However, in this case, I would say that the tube failure was caused by the scale deposits mentioned above, which caused overheating of the tubes.

The heat of the hot gases, containing minute particles of slag, are first absorbed by this slag screen, after which the gases enter the first bank of tubes; so it can be plainly seen that deposits will be greater here, due to the intense heat transmitted to these slag screen tubes.

Why one boiler should fail and the other remain in operation will be a problem for T. E. H. to check again. Several things may be the cause of tube failure—boiler wasn't cleaned properly, operated at a slightly higher rating than the other boiler, concentration and other treatment readings weren't checked carefully—and one boiler may be getting more boiler-water treatment than the other.

Operators should be instructed to check boiler-water samples when they are COOL. Sampling pipe should be blown out thoroughly before taking a sample.

Trisodium phosphate, in "cahoots" with some colloid, is one of the best means of preventing chemical reactions between calcium and silica. It should be carried slightly in excess, when readings are taken of the blowdown water, for the best results and the prevention of burnt-out tubes.

Note: We use trisodium phosphate in our plant for boiler water treatment.

Note: If boilers are located in Kentucky, I would say that the hardness of the raw water is anywhere between 101 and 200, according to the tables.

Fairview, N. J. MARTIN N. GOZDENOVICH

Answer No. 250

How Stop Fuel Waste in This Unit Heater System?

Estlick Advocates Low-Pressure Steam

THERE IS NO reason whatsoever for the opinion that low-pressure steam is not suitable for heating. In our plant we use low-pressure steam of ½ to 1 psi during cold weather and cut it back to atmospheric pressure during the mild periods of the heating season, carrying 6 in. of vacuum on one system and 10 to 12 in. of vacuum on the larger system, and we have no difficulty in maintaining satisfactory temperatures.

The suggestion made to install pressure reducing valves on the steam mains to reduce the pressure for heating, leaving the boiler to operate at higher pressure to maintain adequate pump service, is a sound one. Slight additional radiation may be necessary in some instances, to compensate for the reduction in pressure, but considerable savings in both fuel and in upkeep would be effected by using the lower pressure for heating.

Vacuum pumps are on the market that have a receiver tank equipped with an adjustable vacuum breaker as a part of the unit. These units require no condensing water and therefore there is no build-up of condensate. The pumps are of the centrifugal type and designed to handle the hot condensate.

Low-pressure traps installed at the unit heaters with a sufficient cooling leg between heater and trap, usually 5 to 6 ft long, and a vacuum pump unit as described installed in the return, should help in a large measure to correct the difficulty.

The Nash Engineering Co., South Norwalk, Conn., makes a very good unit of this type. We have one of their units in our plant that has been operating since 1921 with perfect satisfaction.

Ansonia, Conn. WILLIAM T. ESTLICK

Pipe Returns Direct to Heater or Vent Vacuum Pump Suction

THERE IS no justification for the idea that hot condensate, no matter how hot, cannot be pumped, so long as the pump is at the right level or the condensate is under the corresponding pressure. If the pump is 5 ft below the receiving tank, it can handle condensate at 212 F. If the temperature is over 212, the pressure will be correspondingly higher. For instance, the same pump will handle condensate at 250 F because then the pressure will be 15 lb.

The fact that when cold water was injected into the return lines the pump began pumping is no proof that previously it failed to pump because the condensate was too hot. The actual case is different from what H. E. S. supposes. Either some of the traps are blowing or else the flash steam from the near heater units created back pressure, preventing the proper drainage of the farther units.

H. E. S. does not mention any receiver tank for the vacuum pump. A receiver tank is desirable but in this case will not solve the problem if the traps are blowing or if otherwise there is back pressure in the return system to such an extent as to cause some of the remote heaters to be water bound. Venting of the suction of the vacuum pump will solve the problem provided the return lines are properly sized. But this will involve waste of steam and if the steam traps are badly blowing even a vent may not be a solution.

Since all heating is by high-pressure steam in this case, why is a vacuum pump used? The correct thing to do is to pipe the return lines direct to the open heater for the feed pumps. A vacuum pump is used only when the returns are at atmospheric pressure or less.

H. E. S. speaks of a preheating tank mounted above the vacuum pumps. I presume he means the open heater which should be mounted above the feed pumps. He speaks of the boiler being flooded due to too much returns and cooling water. There is something wrong here. If there is too much return it will overflow in the open heater and there is no reason why it should go in the boilers, since under proper operating conditions the speed of the feed pumps is regulated by the fireman to maintain a constant level in the boiler.

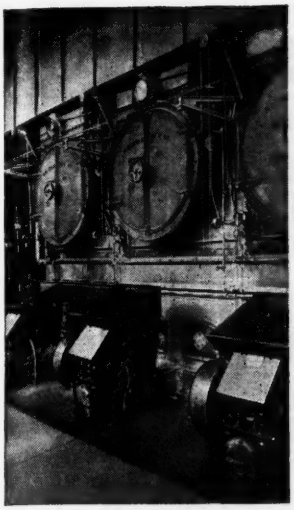
As I see it, the solution of this problem consists of piping the returns direct to the open heater tank. If there is no make-up water of any amount, the flash steam will be lost, which is of no use anyway under those conditions. If for reasons which he has not stated the returns cannot be piped direct to the open heater, then a vent must be provided at the suction of the vacuum pump. In fact a vent is absolutely necessary because, without it, the return line will be under the same pressure or almost the same as the steam line.

Use of a reducing valve for the heating steam depends on the design pressure of the heaters. If they were designed for 75 psi they will not give satisfactory results with 10 psi. Look at the name plate or inquire from the maker. The advantage of reduced pressure is that any leakage will be reduced and the flash steam loss, if any, will be reduced. But since the traps are high pressure they may not give satisfactory results under low pressure.

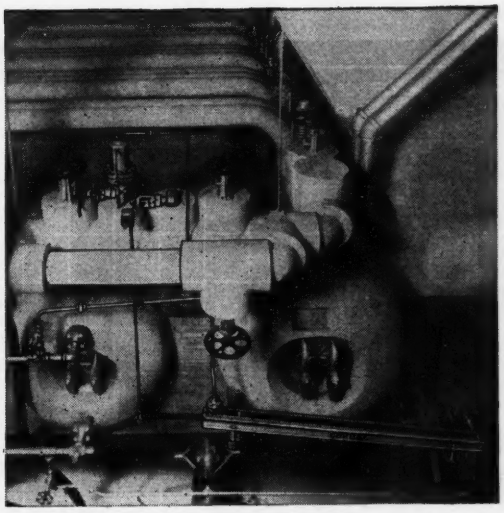
There are really two possible solutions to H. E. S.' problem. The first and best is to pipe the return lines direct to the open heater and if that is not feasible then provide the vacuum pump suction with vent. And check the traps. If they cannot be repaired promptly, pinch down on the valve, giving just enough opening to let out the condensate without any steam blowing.

I advise that a pressure gage be installed on return line system. This gage will tell you when the traps are blowing. If the pressure is higher than normal, then the traps are blowing.

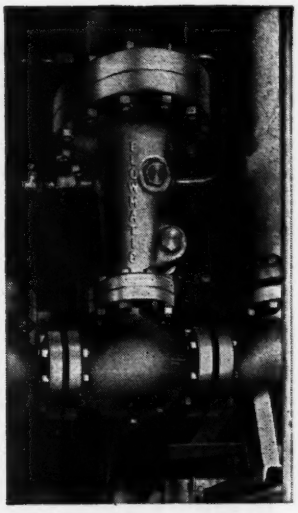
Oak Ridge, Tenn. N. T. PEF



Atlanta Ice & Bottling Co., Atlanta, Georgia. 3 Copes Type OT Regulators installed on HRT Boilers operating at 100 pounds pressure.



Industrial Plant. One of two feed lines to 650-pound pressure C-E Boiler handling a peak of 150,000 pounds per hour, controlled by a Copes Type BI Regulator and Type 3-S-2 Differential Valve.



Eddy Paper Corp., White Pigeon, Mich. Direct-operated Copes Flowmatic Regulator Valve on 550-pound Badenhausen Boiler.

There's a COPES *Feed Water Regulator*
FOR EVERY BOILER REQUIREMENT

SMALL BOILERS?

For HRT, Scotch Marine, and other small boilers, the Copes Type OT Regulator is ideal. Extremely simple, easy to install, compact, direct operated.

Sizes ¾" to 2", 250 and 300 lb. stds.

WATER TUBE BOILERS?

For the conventional water tube boiler subject to ordinary loads, the Copes Type BI Regulator is universally the best known simple level regulator. Fully automatic, thoroughly reliable, smooth acting. Direct or relay operated. Sizes ¾" to 8" all pressure stds.

SENSITIVE BOILERS?

For boilers subject to severe load fluctuations or those sensitive to shrink and swell, the Copes Flowmatic is the correct answer. This steam-flow water-level control is the most rapidly accepted development of recent years. Direct or relay operated.

Sizes 1½" to 8", all pressure stds.

TO be most effective, your feed water regulators must be suited to the particular requirements of the boilers they serve. Boiler design, firing methods, operating procedures, load demands, and space limitations all require consideration.

Whatever your boiler plant characteristics, you will find a Copes Feed Water Regulator that is "made to order." For we manufacture simple level regulators and steam-flow water-level controls in several types, both direct operated and remote relay operated. In addition, every control valve is provided with plunger and ports designed for the existing pressures, temperatures, and rates of flow.

Thus a Copes assures you of individualized feed water control that is in complete agreement with the application. That's one reason why there are over 65,000 Copes Feed Water Regulators in service. For other sound reasons, write for General Catalog No. 12-41.

NORTHERN EQUIPMENT COMPANY

742 Grove Drive, Erie, Pennsylvania

FEED WATER REGULATORS • LIQUID LEVEL CONTROLS • PUMP GOVERNORS
DIFFERENTIAL VALVES • REDUCING VALVES AND DESUPERHEATERS

Branch Plants in Canada, England *Representatives Everywhere*

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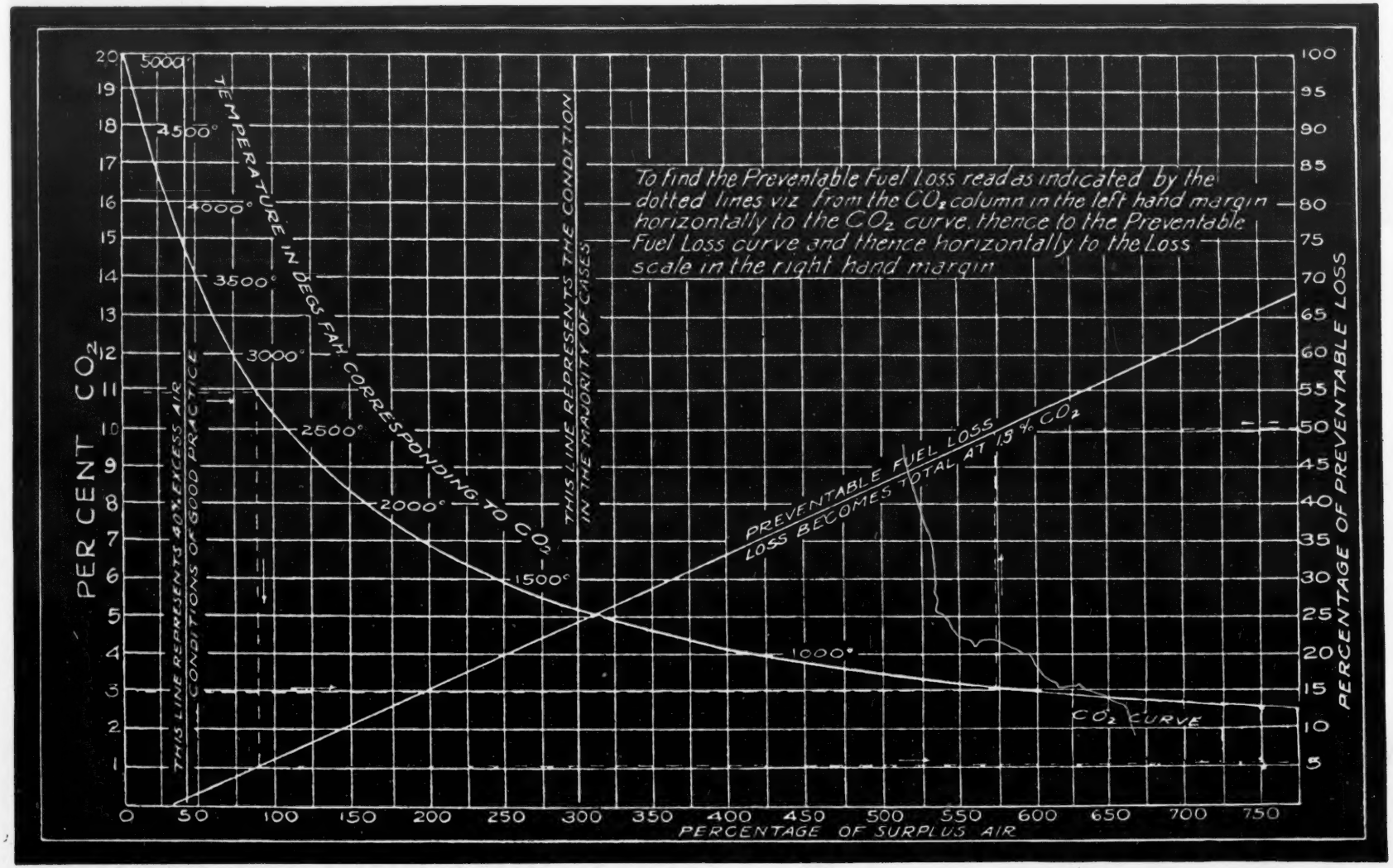

PER CENT CO_2
PERCENTAGE OF PREVENTABLE LOSS
PERCENTAGE OF SURPLUS AIR
TEMPERATURE IN DEGS FAH. CORRESPONDING TO CO_2
5000°
4500°
4000°
3500°
3000°
2500°
2000°
1500°
1000°
THIS LINE REPRESENTS 40% EXCESS AIR — CONDITIONS OF GOOD PRACTICE
THIS LINE REPRESENTS THE CONDITION IN THE MAJORITY OF CASES
To find the Preventable Fuel Loss read as indicated by the dotted lines viz from the CO_2 column in the left hand margin horizontally to the CO_2 curve, thence to the Preventable Fuel Loss curve and thence horizontally to the Loss scale in the right hand margin
PREVENTABLE FUEL LOSS
LOSS BECOMES TOTAL AT 1.5 % CO_2
CO_2 CURVE

RELATIONS BETWEEN CO_2, THEORETICAL FURNACE TEMPERATURE, EXCESS AIR AND FUEL LOSS

PISTON RINGS GET A *Good* "BREAK"

SOLNUS OILS

End Hard Carbon and Stuck Rings . . . Reduce Repairs

Broken piston rings were a common occurrence in a municipal power plant equipped with 300 H.P. 4-cylinder, 210 H.P. 3-cylinder and 120 H.P. 2-cylinder Fairbanks-Morse diesel engines. The rings had to be broken to be freed every time the engines were cleaned . . . until one day they got a good "break." Here's how it happened.

Shutdowns 2 or 3 times a year for cleaning were necessary with the lubricating oil they were using. These shutdowns always disclosed the top rings stuck with hard carbon deposits — so badly stuck they were often broken while being removed. Production delays were too frequent . . . maintenance costs excessive. A Sun Oil Engineer suggested that the trouble was incorrect lubrication, and recommended low-carbon Solnus Oils.

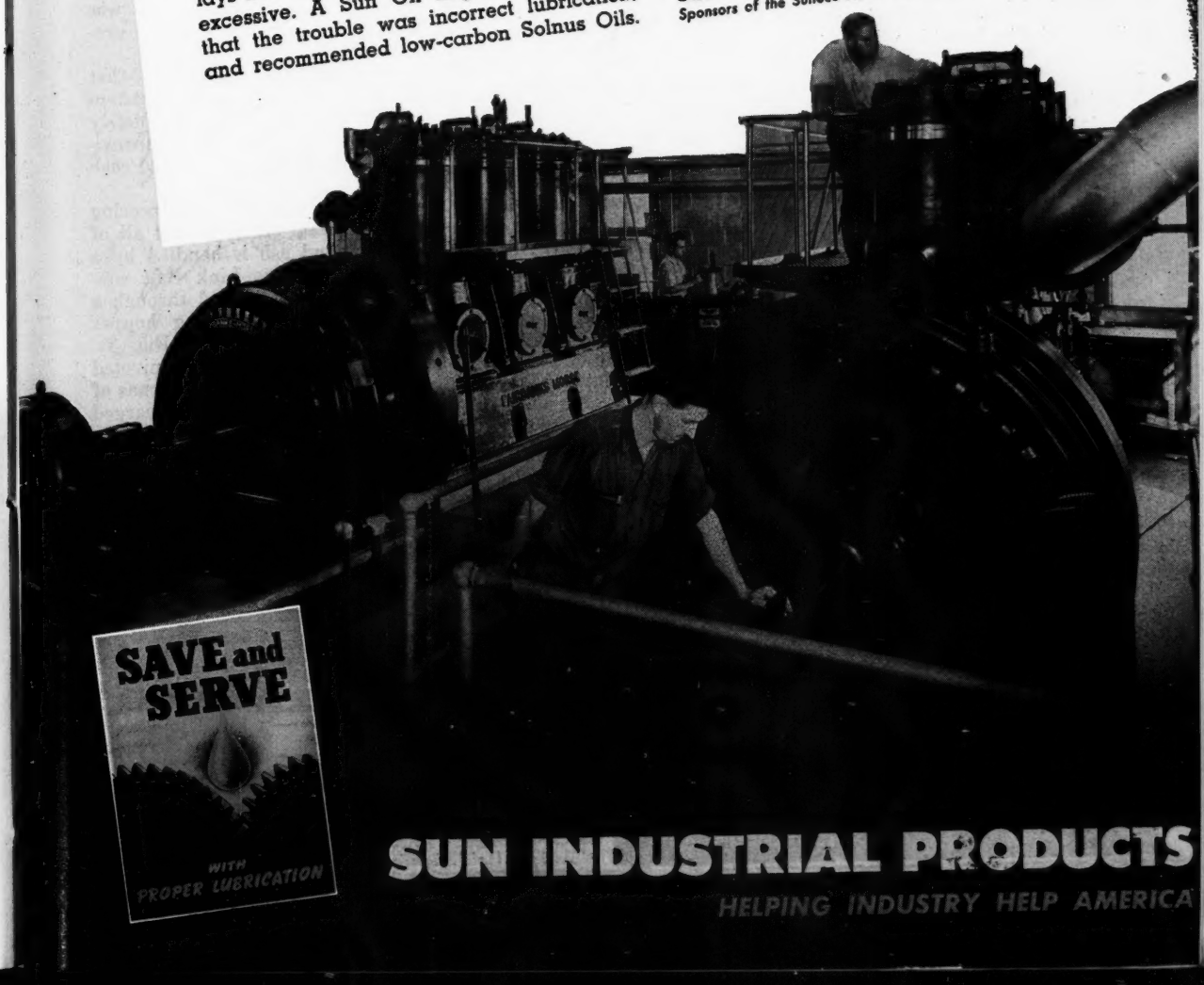
Now only once a year they shut down the engines for cleaning . . . and then never find any hard carbon, never any stuck rings. They are always free and easily removed. Power interruptions have been reduced . . . maintenance time, labor and money saved.

Save and Serve with Solnus Oils. These oils that are low in carbon content, durable, wholly distilled, and neutral in acidity can provide lubrication for your diesels that will save you time . . . equipment . . . labor, too.

Sun has a complete "Save and Serve" Plan including free lubrication booklets, charts, posters, bulletins, etc., which is yours without cost or obligation. . . . Write for descriptive folder.

SUN OIL COMPANY • Philadelphia 3, Pa.

Sponsors of the Sunoco News Voice of the Air — Lowell Thomas



SUN INDUSTRIAL PRODUCTS

HELPING INDUSTRY HELP AMERICA

Fig. 1. General view of Palmer Square, Princeton, N. J.

Anthracite Fuel Heats Princeton Community

Central heating plant of Princeton Municipal Improvement Co. provides all domestic hot water as well as heat for residential district using chain grate stokers to burn barley anthracite under low pressure horizontal return tubular boilers

By Allen J. Johnson, Combustion Engineer
Anthracite Industries, Inc., Philadelphia, Pa.

IN THE POPULAR mind, smoke, grime, dust, noise and utilitarian design are a necessary adjunct of all commercial steam or power plants. For those reasons, a majority of communities limit the location of such units to business or industrial areas or to poorer residential districts. As has been demonstrated at Princeton, N. J., however, it is a relatively easy and inexpensive matter to build such plants so that their presence in a restricted area not only is entirely unobjectionable but also completely unnoticed.

Fronting the historic campus of Princeton University, a block of modern apartments with stores, a theatre, an office building and a hotel, face Palmer Square to form one of the country's outstanding examples of civic planning. This development, known as the Princeton Municipal Improvement Co., is served by a central heating plant which also provides all domestic hot water. As the entire project is in a residential area, there is a rigid smoke ordinance. For that reason, and also because of the picturesque nature of the surroundings, the design of the heating plant presented several unusual architectural and engineering problems.

The architectural problem was solved by a design that, including a brick stack lower than the surrounding structures, does not suggest the nature of the building. To offset the low chimney, a fan was incorporated in the stack to provide adequate draft.

One engineering problem—that of cleanliness—was solved by burning barley anthracite in completely automatic equipment. Approximately 5½ tons are consumed each day.

Another distinctive engineering feature of the plant is that all of the coal and ash is handled by a single continuous Link Belt conveyor. Coal is dumped through a grating into a receiving hopper under the driveway (A, Fig. 3), from which it falls to a pivoted bucket conveyor (B). By means of a traveling tripper, it is discharged at any predetermined point (C) in

Fig. 2 (Left). Exterior view of central heating plant

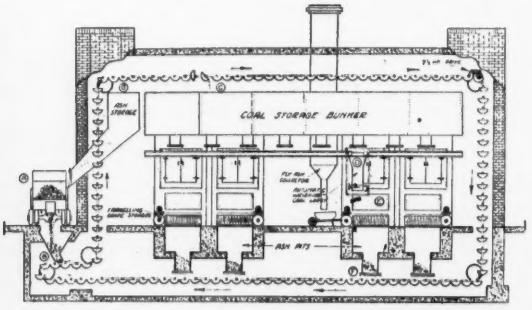
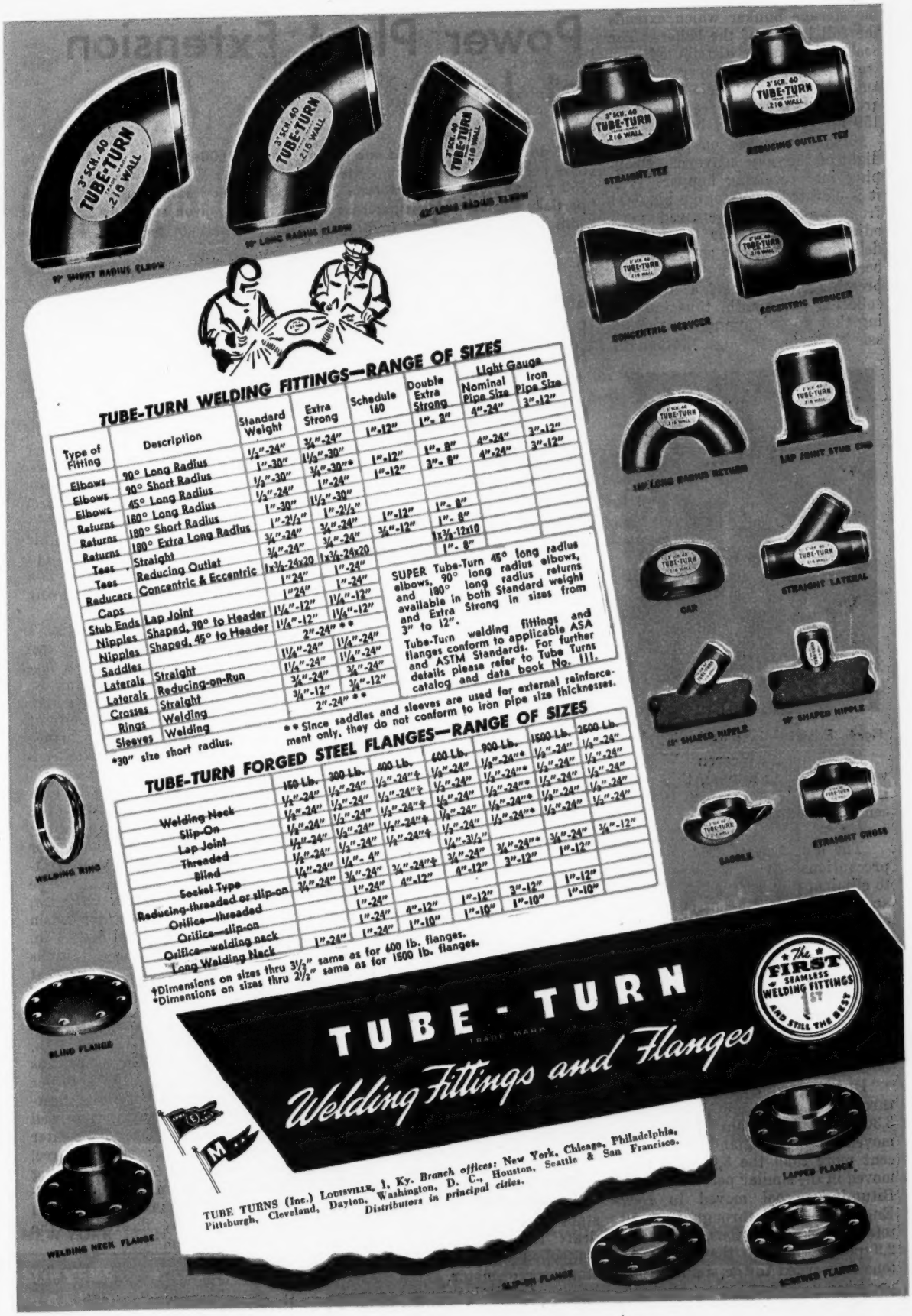


Fig. 3. Vertical cross-section of central heating plant



TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge Nominal Pipe Size	Light Gauge Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"		1"-12"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"	1"-12"	1"- 8"	4"-24"	3"-12"
Elbows	45° Long Radius	½"-30"	¾"-30"*	1"-12"	3"- 8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"				
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	¾"-24"	¾"-24"	1"-12"	1"- 8"		
Tees	Reducing Outlet	¾"-24"	¾"-24"	¾"-12"	1"- 8"		
Reducers	Concentric & Eccentric	1x¾-24x20	1x¾-24x20		1x¾-12x10		
Caps		1"24"	1"-24"		1"- 8"		
Stub Ends	Lap Joint	1"24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24" **					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24" **					

*30" size short radius.

SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12".

Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

** Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"‡	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"‡	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"‡	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"-24"‡	½"-24"	½"-24"*	½"-24"	½"-24"
Socket Type	¼"-24"	¼"- 4"		¼"-3½"			
Reducing-threaded or slip-on	¾"-24"	¾"-24"	¾"-24"‡	¾"-24"	¾"-24"*	¾"-24"	¾"-12"
Orifice—threaded		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—slip-on		1"-24"					
Orifice—welding neck		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	

†Dimensions on sizes thru 3½" same as for 400 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

TUBE-TURN
TRADE MARK

Welding Fittings and Flanges

The FIRST SEAMLESS WELDING FITTINGS AND STILL THE BEST

TUBE TURNS (Inc.) Louisville, 1, Ky. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, Seattle & San Francisco. *Distributors in principal cities.*

the storage bunker which extends the full length of the boilers. The coal, as needed, is distributed by a traveling weighing lorry (D) to any one of the Illinois LF chain grate stokers which feed the four 150 hp Titusville hrt boilers.

Ash is removed on the return flight of the same conveyor. Dropping into receiving hoppers (F), it is elevated to a storage bin (G) from which it is removed periodically by the same trucks that deliver coal. A fly ash trap has been incorporated in the chimney breeching. Only half a barrel is collected per month, thus indicating that a minimum amount of fly ash is passing through the boilers.

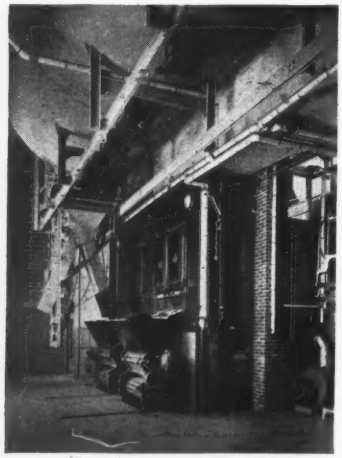


Fig. 4. Firing aisle in central heating plant

Serving a Warren Webster vacuum heating system, this plant is designed to operate at 165 per cent of rated capacity and at only 5 psig.

The use of anthracite, plus the precautions which have been taken to eliminate fly ash, has resulted in an operation which has caused no objections to be raised by the community. Probably the best proof of the smoke and dirt-free nature of the installation is the fact that no complaints ever have been received from the hotel just across the street, even though the top of the heating plant chimney is below the windows of its upper floors.

DURING the calendar year through June 10, approximately 3,309,880 tons of anthracite were moved to New England, or 8.3 per cent more than the 3,055,200 tons moved in the similar period in 1943. Bituminous coal moved to New England in 1944 through June 10 totaled 11,764,581 tons, a rise of 2.9 per cent above the 11,429,829 tons forwarded in the similar 1943 period.

Power Plant Extension at Iowa Falls

Unit design, one boiler and one turbine, to add 7500 kw at 0.8 pf 13,800 v to Iowa Falls station capacity . . . Steam generator for 125,000 lb per hr, 415 psi, 750 F fired by spreader stoker . . . Unusual water treating system, in which partially treated water is purchased from railroad, given additional treatment with special precautions to prevent silica and calcium phosphate deposits

By JOHN M. DRABELLE *Consulting Engineer*
and
P. A. STOVER *Chief Engineer*
Iowa Electric Light & Power Co., Cedar Rapids, Ia.

CENTRAL STATES Electric Co. is now undertaking a major improvement, extension and enlargement of the steam generating station at Iowa Falls, Iowa. The new extension is in keeping with the most modern practice, namely the one boiler-one turbine design, with all auxiliaries and their motors located on the first floor level. The new extension is physically in the same location as the old power station, but the actual physical connections of the old and new sections are the Illinois Central coal track, the water supply above the dam, and the 33,000-v bus.

The new boiler is a Combustion type VU steam generator, operating at 415 psi gage, 750 F total temperature at the superheater outlet and has a continuous steaming capacity of 125,000 lb per hr. Feedwater temperature is 375 F. The unit will be fired by a Detroit Roto-Grate continuous cleaning type stoker consisting of 6 spreader firing sections, 3 per grate unit, and 2 chain grate sections; each section of both the spreader and the chain grate has its own independent driving motors. The furnace will be 13 ft 10 in. deep and 20 ft wide, designed to burn central western coals from Iowa and Illinois. Preheated air is supplied to the stoker by a tubular type air preheater at a temperature of 300 F at maximum load. A by-pass for the control of cold end temperature for light load operation is provided.

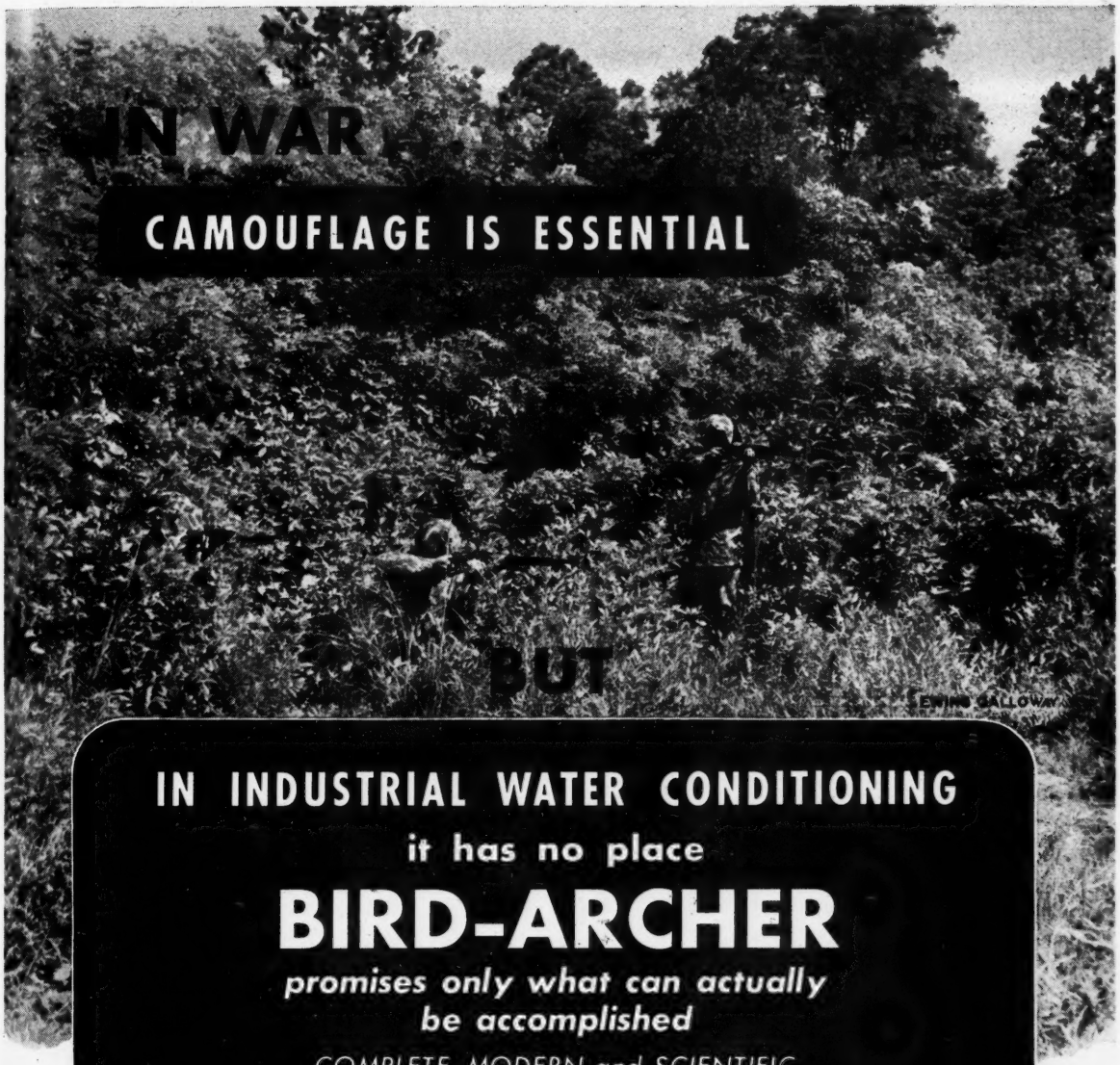
The forced draft fan is inlet vane controlled, driven by a constant speed motor. The induced draft fan is hydraulic coupling controlled and driven by a constant speed motor. The fans are being furnished by the American Blower Co. The cinder catcher is a Western Precipitation unit, placed between the air preheater and the induced draft fan. Combustion control is by a Bailey air operated system; feedwater control is a Bailey 3-element unit. A filter is provided between the air supply and the control system, and the control system compressor is a non-lubricated, 2-stage unit, using carbon packing rings.

The turbine-generator is a Westinghouse 7500-kw, 3-phase, 60-cycles, 13,800-v, 0.8 power factor unit, with a shaft-driven exciter with pilot exciter, to give high rate of response under short circuit conditions. A generator surface air cooler with thermostatic control cools the generator.

The steam end of the turbine is built for 400 psi initial throttle pressure, 750 F total temperature, with 3 steam extraction points for feedwater heating in 3 closed heaters and one deaerating heater. The capacity of the unit is 9375 kw, heating its own feedwater when exhausting at a vacuum of 2½ in. Hg abs. Under winter conditions the unit will deliver 9375 kw, heat its own feedwater, extract 15,000 lb of steam per hr to the central hot water heating system when exhausting to the condenser at 1 in. Hg abs. The second or 55 psi abs point supplies steam (15,000 lb per hr) to the central hot water heating system heat exchanger, as well as steam for extraction heater No. 2. From this same source, steam is admitted to the deaerating heater by a thermostatically controlled valve as makeup for steam not furnished by flash from the blow-down system.

The condenser is a Westinghouse 11,000-sq ft, two-pass, ver-

(*Continued on Page* 138)



IN INDUSTRIAL WATER CONDITIONING
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NEW YORK 17, N. Y. • CHICAGO 11, ILL. • PHILADELPHIA 40, PA. • MONTREAL, CAN.

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Prevent Lengthy Shut-Downs for Valve Repairs

Fairbanks Renewable Composition Disc Valves, with quickly replaceable slip-on disc holders, prevent lengthy shut-downs for valve repairs. The complete disc assembly can be easily and quickly replaced and service resumed without removing the valve from the line.

Other outstanding features, including Protected Top Seat for repacking and radial body-bonnet joint, are fully described in Catalog No. 42. Write today for your copy and the name of the nearest Fairbanks distributor.

THE FAIRBANKS COMPANY

393 LAFAYETTE STREET NEW YORK 3, N. Y.

BOSTON, MASS. PITTSBURGH, PA.

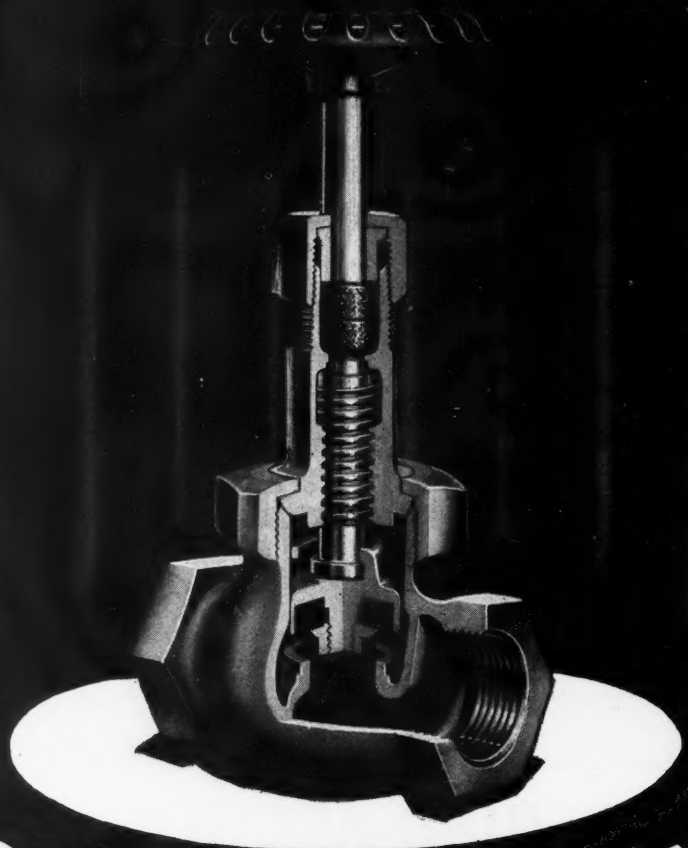
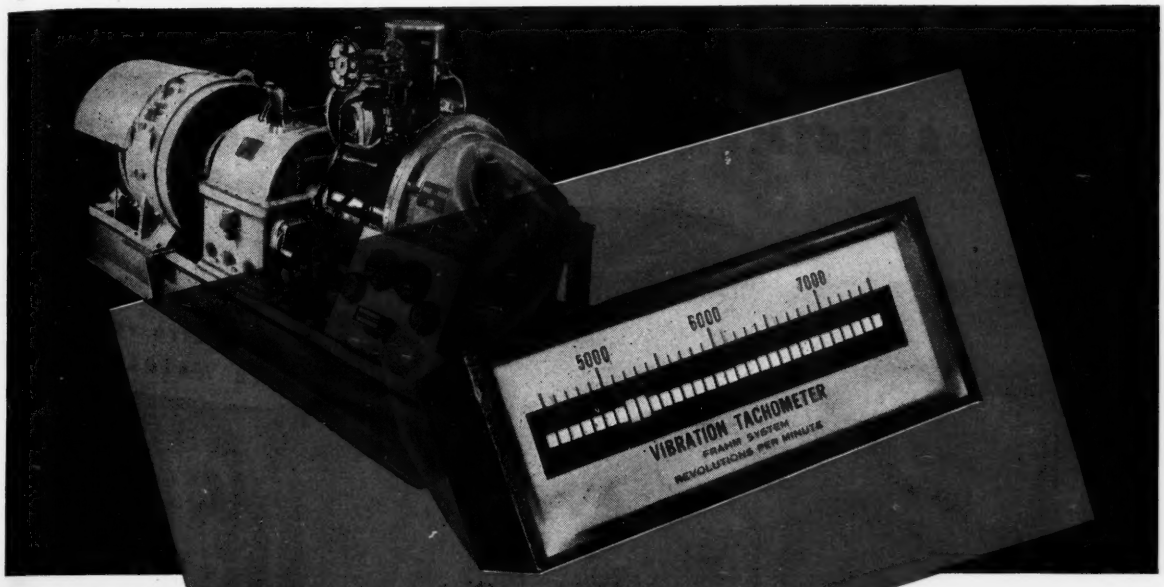
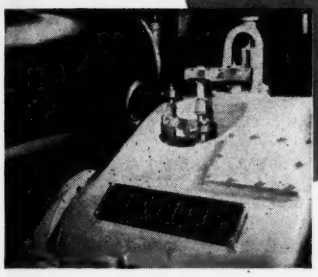


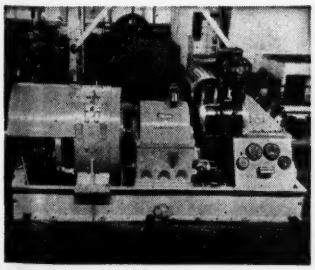
Fig. U-01

FAIRBANKS RENEWABLE VALVES





The simplicity of the Hendy governor is shown in this view. Power unit for the governor is an integral portion of the reduction gear assembly.



Over-all view of the 300 kw, 220/440-volt Hendy Turbo-generator, showing the sturdy welded steel bedplate and the compact arrangement of the complete set.

RIGHT ON THE NOSE

AT 5250 R.P.M.

Two important factors are brought out by that statement . . . first, Hendy Turbo-generator governors *hold* speed accurately regardless of load fluctuations; second, Hendy engineers, in their search for new and improved methods and materials, have made another valuable contribution to the operating efficiency of power-producing machinery.

The governor on Hendy turbines is greatly simplified over former types, requires no stuffing boxes or soft packing, utilizes anti-friction bearings in the linkages, and is enclosed within the gear-case. Individually, none of these new practices would materially affect closer speed regulation—but together, and combined with precise workmanship, they assure fine speed control over the entire range of no-load to overload conditions—resulting in uniform generator performance.

Hendy Turbo-generators are available for a-c or d-c output—from 250 to 750 kw capacity. Inquiries are invited on these standardized units—as well as on larger plants that will be available in the near future. Write for new booklet which gives more complete information.

JOSHUA HENDY Division

JOSHUA HENDY IRON WORKS

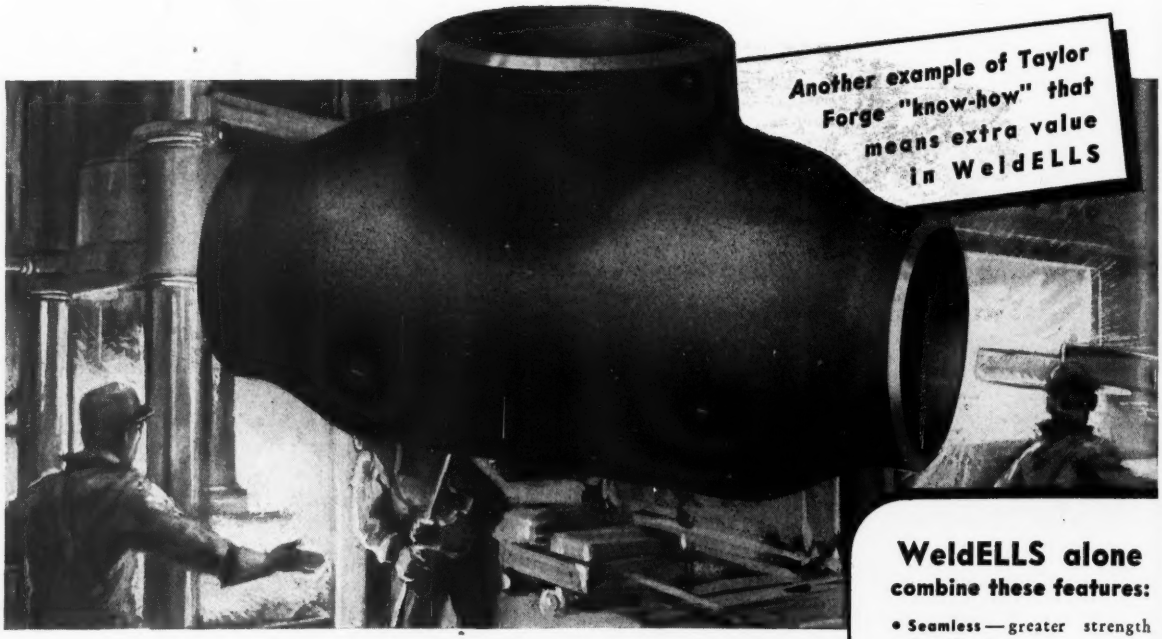
SUNNYVALE, CALIFORNIA

34-V

EST. 1856

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • ST. LOUIS • WASHINGTON • LOS ANGELES

RARE SPECIMEN IN WELDING TEES—



● *When you think of a reducing tee you always picture it as reducing in the branch. But this one, for the peculiar purpose it serves, had to be made the other way around. It's a seamless, carbon-moly forging, five inches in the run with a seven-inch branch—an "increasing" tee, so to speak; one more example of those kinks that are found so abundantly in the Taylor Forge bag of tricks.*

The "know-how" acquired during many years of performing these special—often extremely difficult—manufacturing operations, has a mighty important bearing on our standard line of WeldELLS, Welding Tees and other Taylor Forge Welding Fittings.

It means that in developing WeldELLS we did not have to ask what kind of fitting is easiest to manufacture. Instead we asked what comprises the ideal fitting, and then, with every special facility and process at our command, made that conception a reality.

That is why WeldELLS have tangents . . . why they have extra reinforcement where service stresses are greatest . . . why they have such extremely accurate dimensions . . . why they have the features listed opposite . . . why, in short,

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS *have everything*

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
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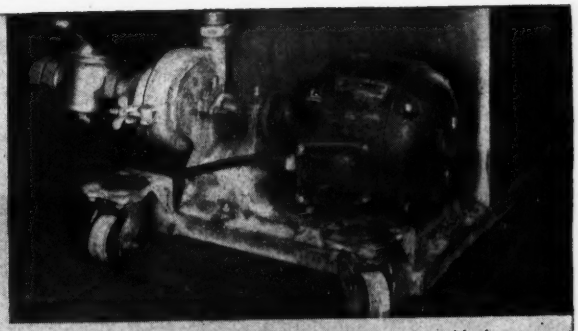
DOUSED DAILY!

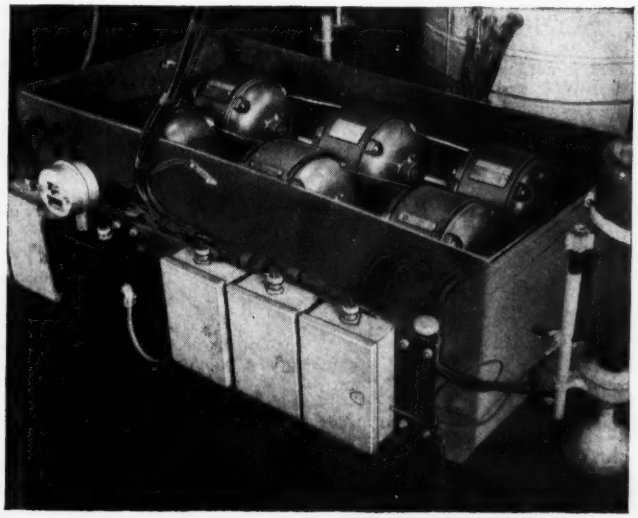


G-E Tri-Clad motor coupled to a centrifugal pump on a portable cleaner in the milk plant of H. P. Hood & Sons, Inc., Charlestown, Mass.

POWERING A DAIRY PUMP, this Tri-Clad splashproof motor gets a dousing every day as the plant is hosed down. After years of service, frame and end shields are virtually uncorroded, insulation is going strong. G-E "protection tests", both in the development of the Tri-Clad design and in our daily production, help us assure you of long-lasting service from Tri-Clads on motor-wracking jobs like this.

"Hot Box" at 100% humidity tests TRI/CLAD motor protection

REG. U.S. PAT. OFF.

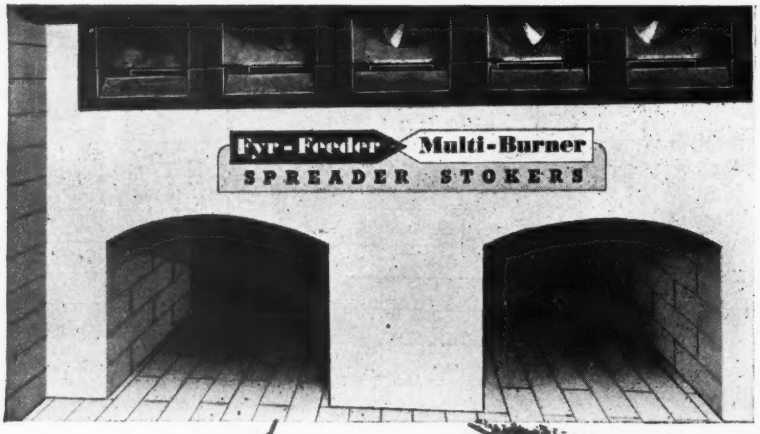


Here is one of the many development tests which helped to prove the *extra* stamina engineered into the Tri-Clad design. In the bottom of this moisture box, just below the motor base, two inches of water was maintained at 212 F. The cover kept the humidity within the box at 100 per cent. By operating motors in this atmosphere to the breakdown point, G. E. got the low-down on the coil insulation's moisture resistance. Tri-Clad motors, in both open and splashproof construction, showed up unusually well in this extra-severe test. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Every week more than 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.



SAVE COAL...

with FYR-FEEDER Multiple SPREADER Stokers

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of wet or dry bituminous coal you have available locally — screenings or sweepings, any melting point of ash, free-burning or coking coals.

Burns Coal like Oil: FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed — no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle increased loads.

FYR-FEEDER is our own original design. FYR-FEEDER is not a copy of any other stoker but our own invention developed by us, and our engineering experience with spreader stoker design, installation and operation began in the last century.

WET COAL IS NO HANDICAP

Coal men like the FYR-FEEDER because FYR-FEEDER users do not insist upon the delivery of "DRY" coal since FYR-FEEDER handles "WET" coal satisfactorily. Regardless of "rain and snow watered" coal, FYR-FEEDER stokers produce plenty of steam from "WET" coal. FYR-FEEDER was designed to use "WET" coal or dry coal.

AMERICAN COAL BURNER COMPANY

—Engineers—

22-18 E. Erie St., Chicago 11, Ill.

Wire for Information or Survey.

Specify Horizontal Return Tubular or Water Tube Boilers.

TREND TO SPREADER STOKERS

There is a definite trend to the use of more and more Spreader Stokers in small, medium and large Industrial Installations.

WHY do so many engineers now consider the Spreader Stoker superior to all other methods of coal firing?

THE FYR-FEEDER MULTIPLE SPREADER STOKER is the World's BEST Spreader Stoker.

The Best Is Vital Now

In ordinary times it is BEST to get the BEST. In times of emergency, when there is an urgent demand for saving coal and man-power, the BEST is a vital necessity.

The FYR-FEEDER Spray-Spred method of firing combines the advantages of the old-style Spreader Stoker and the Pulverized Coal Burner, using only the BEST features of each method plus other FYR-FEEDER advantageous features.

The following questions present themselves:

I. *WHY is the FYR-FEEDER superior to all other types of Spreader Stokers?*

II. *WHY is FYR-FEEDER the World's Simplest Automatic Stoker?*

III. *WHY is FYR-FEEDER the best Industrial Bituminous Coal Burner?*

IV. *WHY and how does FYR-FEEDER save coal and man-power?*

V. *WHY and how does FYR-FEEDER reduce maintenance costs?*

VI. *WHY is FYR-FEEDER the best method of burning WET or dry "coal screenings," bug dust or yard sweepings?*

Fyr-Feeder Stoker Sizes

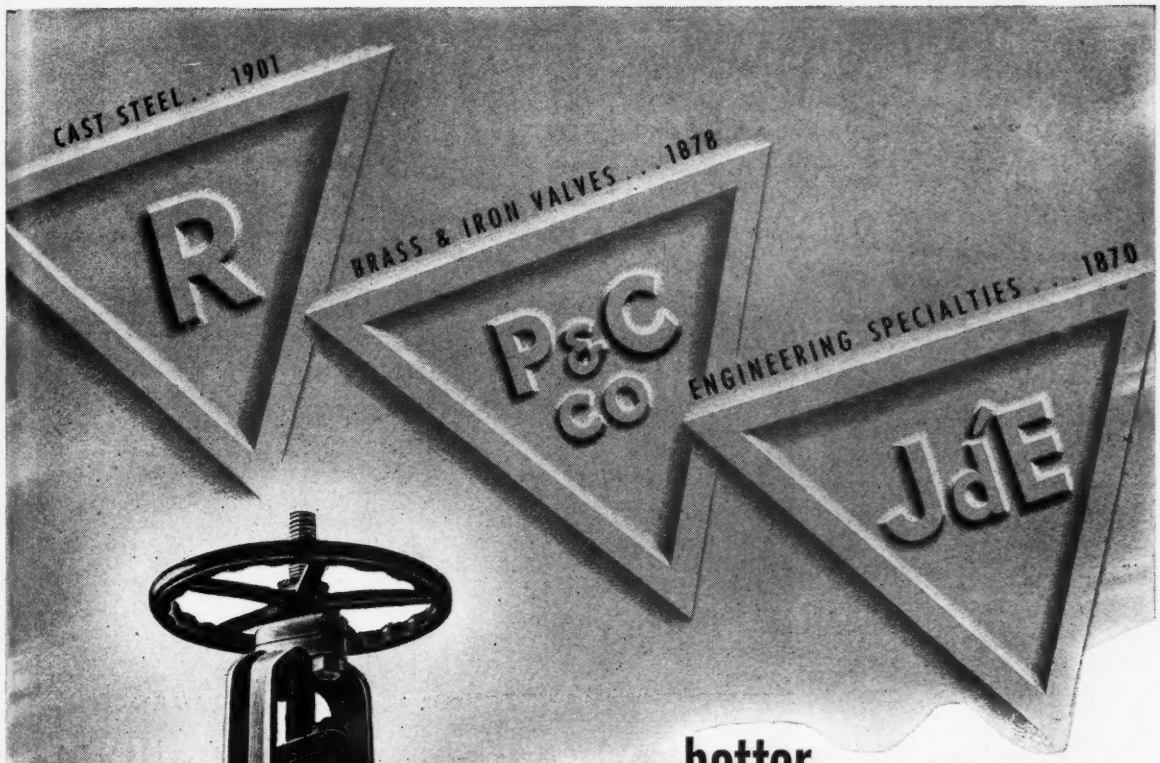
FYR-FEEDER Multi-Burner Stokers are built in sizes that will burn from 300 to 12000 lbs. of coal per hour If you expect to be in the market for Automatic Coal Burning Equipment —WIRE

FYR-FEEDER

Spreader Stokers

Chicago 11, Ill.

© by American Coal Burner Co., 1944



YOU GET better VALVES THROUGH R. P. & C. SPECIALIZED PRODUCTION

"READING" Cast Steel Valves and Fittings are made by an organization that has devoted its whole life to developing pressure steel castings—castings finished into valves and fittings in accord with designs for high temperature service.

"PRATT & CADY" patents for brass and iron valves, now expired, show its participation in early developments of the valve industry—particularly the development of renewable features.

"D'ESTE" was an original manufacturer of reducing valves and pressure regulators—introducing the piston internal pilot control type.

★ ★ ★

Thus, READING-PRATT & CADY *offers you a single source for your valves. Whether they be of cast steel, brass or cast iron, or whether they be manually operated gates, globes, checks, et cetera, or automatically controlled regulators—they are made by an organization experienced, tooled and manned for the production of its particular type of valve, but each able to give you every advantage of the best thinking of the others. You get better valves through* R. P. & C. *specialized production.*

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MANUFACTURERS OF
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STRENGTH

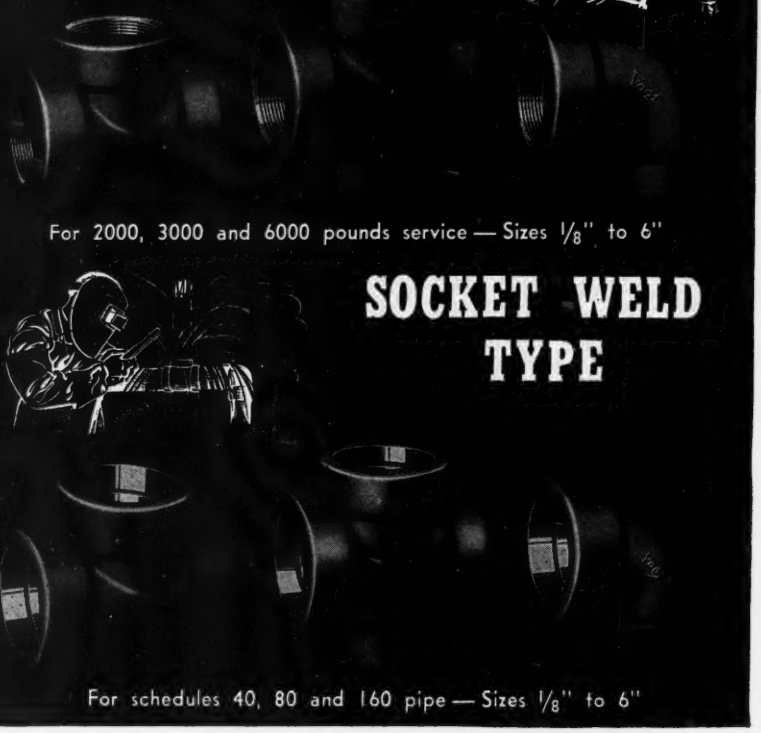
FOR SAFETY AND LONG-TIME SERVICE

Specify

Vogt

DROP FORGED STEEL FITTINGS

SCREW END TYPE



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SOCKET WELD TYPE

For schedules 40, 80 and 160 pipe — Sizes 1/8" to 6"

Round-the-clock operation of oil refineries, chemical plants, steam plants, etc., essential to the continuous flow of war products to the United Nations, is all in the day's work for these fittings. Today, as in peacetime, Vogt drop forged steel fittings make a major contribution to the efficient functioning of pipe lines in plants vital to the war effort.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy.

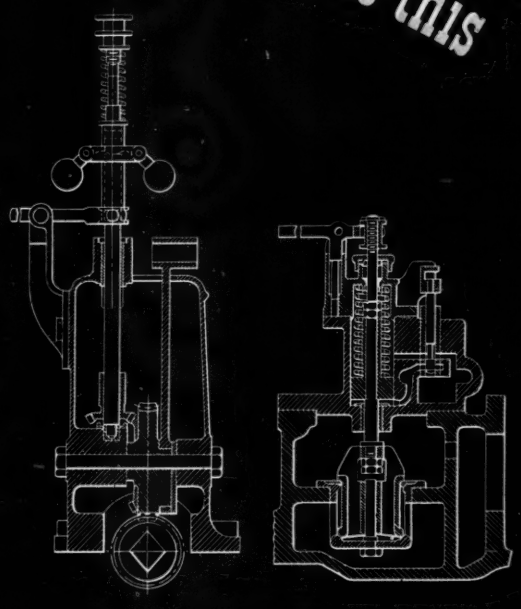
Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KY.

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

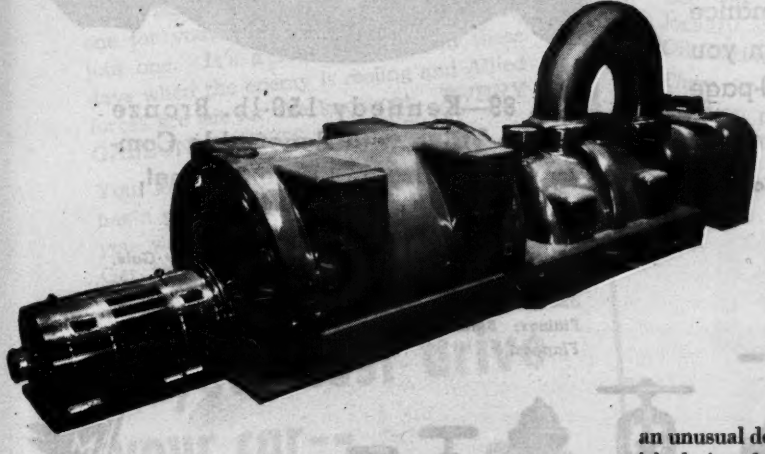
When GOVERNORS were made like this

Lubricating this "Cost Governor" of 1894 was no particular problem. Clearances were ample, mechanism simple. Steam was admitted in blasts, longer or shorter, according to the load on the machine. Attached to the spindle of the double-beat throttle valve was a piston which was normally pressed downwards by a spring above it. Steam leaking at a slow, but determined rate through the bushing of the spindle raised the pressure below the piston and so tended to keep the valve open in opposition to the action of the spring. The emergency shutdown device operated by releasing the steam under the piston of the double-beat valve, allowing the spring to hold the valve permanently shut. In modern types, oil pressure, instead of steam, is used to control the governor mechanisms.



a 1-Job turbine oil would do

...But modern governors need this 2-JOB oil!



The precision mechanism of the governors on today's turbines need an oil that will do more than just lubricate. They need an oil that *prevents rust* as well as one that *resists oxidation* to an unusual degree. Shell Turbo Oil does both.

SHELL
TURBO OIL

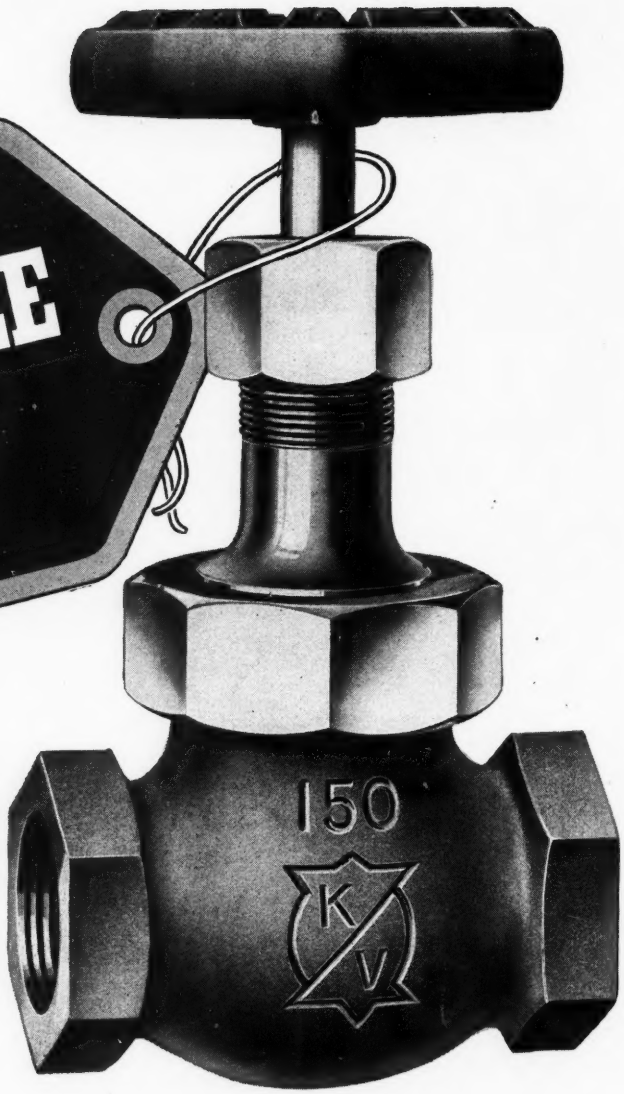
1. That prevents rust

2. That has superior oxidation stability

The governor on a modern turbine is, of necessity, built to such close tolerances that rust can stop it cold. That's why "that old reliable oil you've been using for years" is out of place in a modern, high-speed job. Today you need a turbine oil that does 2 jobs at once: (1) *prevents rust*, (2) *resists oxidation* to an unusual degree. Shell Turbo Oil does both. Why? Because it's designed for modern turbine use.

A smooth-running turbine today is no measure of tomorrow's performance. Don't wait for rust to strike. Change to Shell Turbo Oil. First of its type to be approved as meeting rigid U.S. Navy specifications, Shell Turbo Oil has built a reputation no turbine operator can ignore. Boasting? No! Facts prove it's so. Why not have a Shell man call and show you the record? Write: Shell Oil Company, Inc., 50 West 50th Street, New York 20, N.Y., or 100 Bush Street, San Francisco 6, Calif.

FOR DEPENDABLE VALVE SERVICE

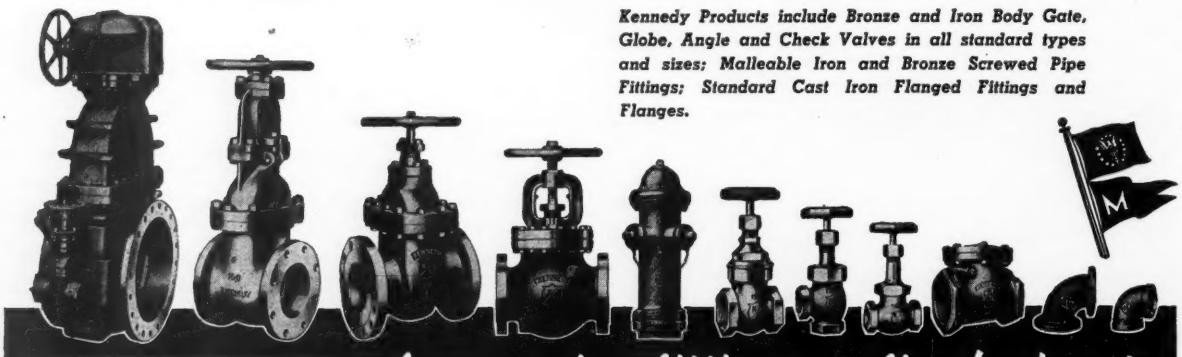


Two generations of engineers who have used Kennedy Valves know that they are thoroughly reliable in every respect. Every Kennedy Valve type can be depended upon to close tight, open easily, and give lastingly good service with minimum attention and maintenance expense. You are safe when you standardize on Kennedy. 240-page catalog sent on request.

The Kennedy Valve Mfg. Co.
Elmira, New York

Fig. 89—Kennedy 150-lb. Bronze Globe Valve with Renewable Composition Disc and Union Bonnet.

Kennedy Products include Bronze and Iron Body Gate, Globe, Angle and Check Valves in all standard types and sizes; Malleable Iron and Bronze Screwed Pipe Fittings; Standard Cast Iron Flanged Fittings and Flanges.



KENNEDY *valves...pipe fittings...fire hydrants*

OIL CONSERVATION PAYS *DOUBLE DIVIDENDS* these days

Gasoline powers the attack

Do you drive ALONE? Do your employees drive ALONE? Cooperate with the current OPA campaign to "Share the ride."

Join a ride-sharing club yourself . . . form one for your employees or urge them to join one. It's a solemn obligation these days when the enemy is reeling and Allied forces are set for the knockout. EVERY GALLON COUNTS DOUBLE!

Your local War Price and Rationing Board has a procedure that will help you . . . if you want riders or if you want a ride. Get the information now . . . use your telephone.

If you must drive your car-- *Share it*

Properly filtered oil saves oil and engines

Keeping oil clean lowers oil consumption . . . reduces engine wear . . . assures better performance.

Check your oil filter regularly—on your automobile and on your industrial engines. Replace the refill cartridge when necessary —keep your oil *Physically, Chemically,* and *Visibly* clean at all times.

See the Briggs representative in your locality. Let him show you how Briggs Oil Clarifiers clean oil 3 TIMES—3 WAYS. There is a Briggs Clarifier for every oil filtration problem for every type internal combustion engine.

Briggs

PIONEERS IN MODERN OIL FILTRATION

BRIGGS CLARIFIER COMPANY
1339 WISCONSIN AVENUE, N.W.
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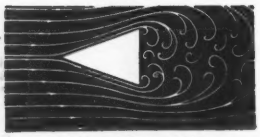
HOLDS THE PRESSURE SETTING VERY *Accurately..*

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

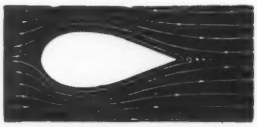
THE "Type 1000" Valve gives users absolute control of pressures. The reduced pressure is held constant regardless of variations in the initial pressure or variations in demand.

FIG. 1



YOU DON'T GET THIS TURBULENCE

FIG. 2



YOU GET THIS STREAMLINED FLOW

This operating feature eliminates all chance of changes occurring in the processing or of damage to product.

When there is peak demand to be met, your "1000" Valve is easily able to do it, holding the pressure constant at the same time.

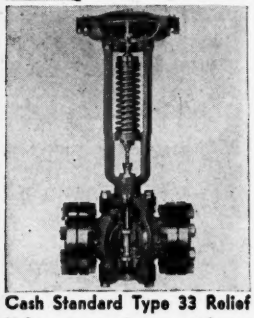
There is no downstream turbulence in your "1000" Valve. (See Fig. 1). The flow of steam, air, oil, etc. is streamlined (see Fig. 2) for straight flow through the delivery passage and jet. All of the process of pressure reduction occurs where the valve throttles flow and not on the downstream side of the valve. That is one of the feature results of streamlining. Therefore, there is no downstream turbulence and you have close delivery pressure control at all times.

Write for Bulletin "1000"

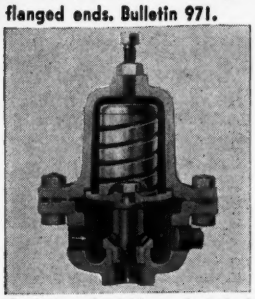
CASH STANDARD CONTROLS VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

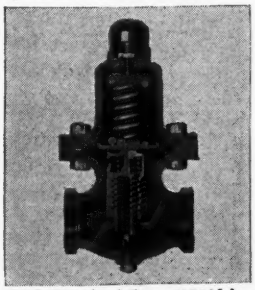
OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 33 Relief Valve; in various metals to handle nearly all fluids. Has Roller guides on valve spindle; also roller bearing to take care of spring torsion. Sizes ½" to 3" screwed ends; 1" to 12" flanged ends. Bulletin 971.



Cash Standard Type Q Relief Valve has side inlet, bottom outlet. Popular for pump by-pass use. Sizes ½" to 2" screwed ends. Relief pressures up to 350 lbs., temperatures up to 500°F. Bulletin 943.



Cash Standard Type 4190 Valve for relief (bypass) use; holds constant valve inlet pressure regardless of changes in load or outlet pressure. Multiport—large capacity. Iron or bronze bodies; iron or bronze trim. Sizes ½" to 2" screwed ends; 2" to 6" flanged ends. Bulletin 952.

NO "Global Strategy" NEEDED

with POWELL Engineering at your service....

Fig. 1793—Large Size Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes, 2" to 30", incl. Also available with taper wedge double disc.—Fig. 1444.

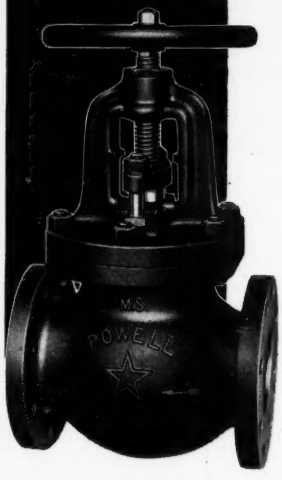


Fig. 241—Iron Body Bronze Mounted Globe Valve for 125 pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke bonnet and regrindable, renewable bronze seat and disc.

Guessing and gazing are out when it comes to buying your flow control equipment. Because, for even the simplest operation, the valve must be of correct design to obtain maximum efficiency. This not only includes basic type, such as Globe, Angle, Gate, "Y", Check, Relief and Non-Return, but such factors as suitable stem action, bonnet construction, working pressure and especially the materials used in the body and mountings.

POWELL Engineering has developed a complete line of valves that meet every demand in the vast field of power. The valves shown here are but a few of the **POWELL** line of iron body, bronze mounted valves of all types especially adapted for *low pressure steam* and *water lines*.

And to assist you in selecting the correct valves for your individual requirements, **POWELL** Engineering is always at your service for consultation and advice.

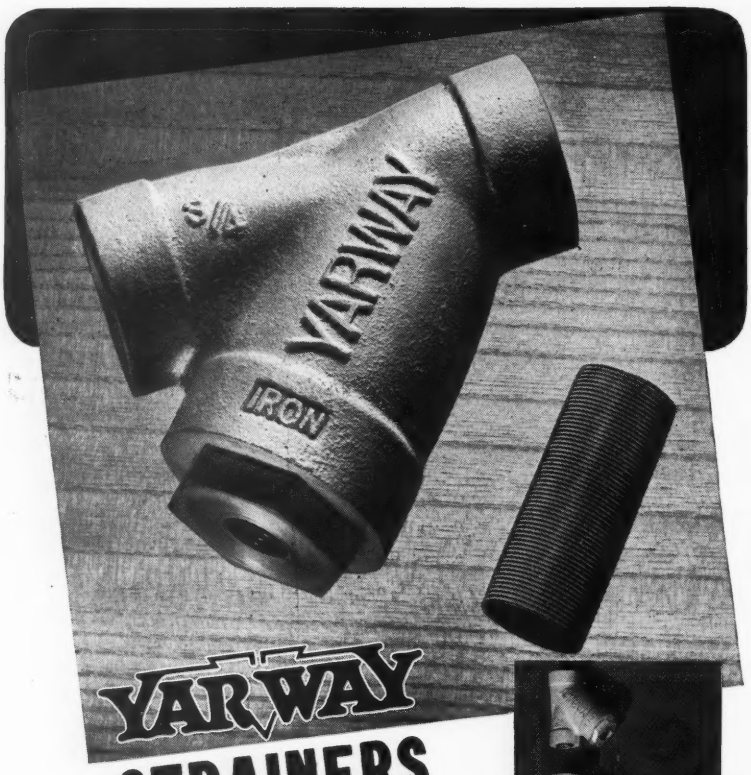
The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

Fig. 559—Large Size Iron Body Bronze Mounted Swing Check Valve for 125 pounds W. S. P. Has flanged ends, bolted flanged cap with ample number of bolts, and regrindable, renewable bronze seat and disc. Sizes 2" to 16", inclusive.

POWELL VALVES



YARWAY

STRAINERS

"Police the Pipelines"

YARWAY STRAINERS are *selling by the thousands* because they are better engineered for the service.

"*The Screen is the Thing*"—a high-grade, woven Monel wire screen that stops the dirt, lets fluids flow freely.

Then, too, purchasers like the *body finish*—*Cadmium plating inside and out* for protection against corrosion.

And last but not least, it is "*Easy to Clean*" having a steel blow-off bushing, precision machined with straight thread. Screen and bushing come out together—go back together, automatically aligning.

Six sizes, ½" to 2" for pressures up to 600 lb serve practically all strainer needs.

Sold by over 100 Mill Supply Houses. See your Supply House or write for Bulletin S-200.

YARNALL-WARING COMPANY
114 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

ASRE Discusses Problems New and Old at Annual Meeting

(*Continued from page* 87)

tamination were reported. Use of ultraviolet lamps to provide radiation of wave length 2537 was suggested as the most powerful bactericidal agent feasible for food storage. This lamp will also give sufficient radiation of wave length 1850, which produces ozone. Both radiation and ozone, the speaker said, destroy almost all the odor and taste bearing molecules.

Further data on lamp radiation for use in refrigeration were given by R. C. Hultgren, production engineer, General Luminescent Corp. He described The Use of Cold-Cathode Fluorescent Lighting in Refrigerated Areas. Details of the cold cathode lamp, operating at temperatures of 30 to 36 F were given. The need for such lamps has arisen during the war in beef grading, one of the major problems in packing houses. Higher production of meat, relation of price to grade, personnel shortages, make proper lighting of beef grading coolers a major problem.

Control of a Temperature Altitude Chamber, a special job requiring reduction of temperature in an aircraft testing chamber from +80 F to —76 F in 2 hr, holding the temperature at the lower value for 4 hr then raising it to + 167 F in 45 min, was discussed by F. W. McKenna, The Vilter Mfg. Co. To do this a program controlled semi-automatic system was worked out.

In connection with this and similar problems that have resulted from the activities of the aircraft industry, Heat Flow Rates with Rapid Temperature Changes in Enclosed Spaces were given in a paper by H. B. Pownall and S. P. Soling, Mechanical Engineering Department, York Corp.

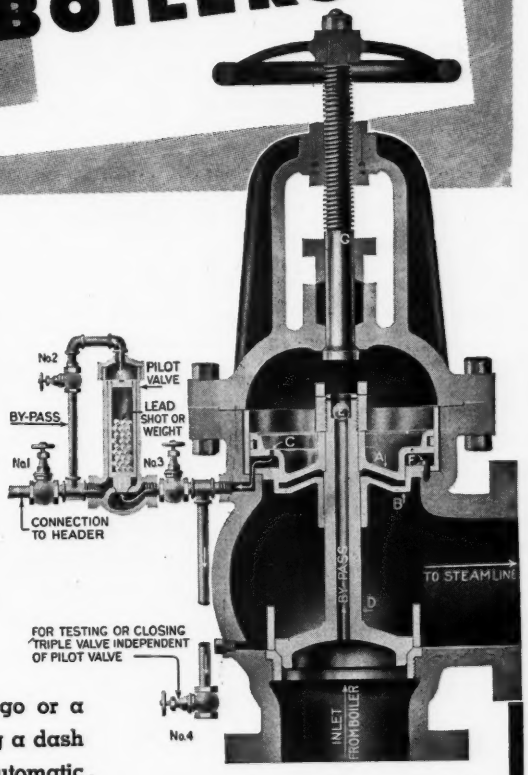
In a paper on Blast Freezing Plants, Earl D. Pollock, Export Manager, The Vilter Mfg. Co., pointed out that previous treatment of the blast freezing of food products has for the most part been primarily concerned with freezing at relatively low air velocities. In this paper, the author considered velocities across the surface of the package of from 50 to 3200 ft per min.

One result of the higher velocity, he stated, is an improvement in quality incident to the reduction in freezing time, with its consequent effect on type of crystal formation. Supporting data on freezing of fish, cherries, vegetables, and meat are given. Control of "freezer burn" or surface dehydration is discussed, the author contending it is less at higher velocities. Also by designing the air circulating system to decrease the moisture carrying capacity of the air, it will be decreased.

Hydrocarbons Refrigerants in Low Temperature Fields was presented by Harry D. Edwards, The Linde Air Products Co. He stated that the problems of supplying low temperature refrigeration in war work and the dif-

FIRST AID
FOR INJURED BOILERS

G-A TRIPLE ACTING NON-RETURN VALVES Shut Down Steam Flow *Automatically*



When the unexpected happens and a boiler tube lets go or a steam line bursts—will an operator risk his life in making a dash to shut off the valve? No—he won't need to, if a G-A Automatic Triple Acting Non-Return Valve is on the job.

For more than 30 years G-A Triple Acting Non-Return Valves have been providing dependable "first aid" for injured boilers. They give maximum protection because they work two ways—automatically shut down steam flow from the boiler in case of bursting line—also prevent reverse flow into a damaged boiler. Write for free catalog describing complete G-A line.

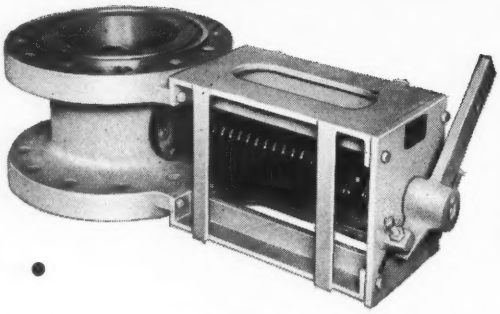
Also

Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check Valves, etc.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. • • • PITTSBURGH, PA.

QUICK Shut-off
Under High Pressure and Temperature



No. 570

Ring joint 300-pound flange with air cooled stuffing box. Hand lever operated for temperatures up to 1900°F.

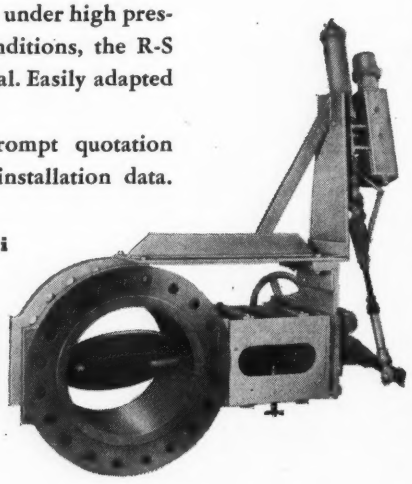
A widely diversified line of special R-S Butterfly Valves to meet individual specifications in the high pressure and temperature ranges are in constant production.

Either or both the body and vane can be fabricated from non-corrosive, non-abrasive and acid-resisting metals. Pressure iron castings can be alternated for vital war metals, at considerably lower cost.

For fast, easy control and shut-off of volume and pressure, even under high pressure and temperature conditions, the R-S Butterfly Valve has no equal. Easily adapted to power operation.

Write for Catalog. Prompt quotation furnished on receipt of installation data.

15 to 900 psi



No. 607

Operated for control at elevated temperature. Raised face flanges, finned lubricated stuffing box and hydraulic cylinder positioner with handwheel and declutching unit (patent applied for).

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Avenue • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

ficulties of obtaining customary refrigerants has led to much interest in the use of hydrocarbon refrigerants, some of which are used in chemical and refining processes, and of which there is an available supply. Properties and specifications of a number of them such as methane, ethane, propane, pyrofax gas, butane, isobutane, ethylene, propylene, and butadiene are given. A table of thermodynamic properties of ethane, from —148 F at 7.62 psi abs to +90.1 F at 707.8 psi abs is given.

The hydrocarbon refrigerants not only permit low evaporating temperatures, but are used in essentially the same type of equipment; any materials of construction can be used except rubber. Comparisons of the cost and operating factors involved, says the author, shows that a plant to use a hydrocarbon refrigerant is worth considering—C R E

The Design and Maintenance of I.D. Fan Installations

(*Continued from page* 90)

abrasive contents in passing through the fan.

Factors to Consider in Buying I. D. Fans

It is the writer's opinion that the purchaser of an induced draft fan should select this important unit of equipment with extreme care and the following suggestions are offered:

1. The volume of flue gas to be handled should be specified in terms of cfm instead of lb per hr of gas. From this we next determine from the design of breechings and their inlet and outlet connections, where the fan is to be located and the space available for the installation. Next we consider the type of driving equipment we desire to use, and the power costs. Fuels to be burned should be carefully studied. With this information before us as the main factors, we then should select a fan sufficient to permit 20 per cent over and above nominal operation requirements, and particularly so when fuels are subject to frequent change, frequent changes in load, boiler cleanliness, and reasonably air tight settings, ducts and flues. Select your induced draft fan on the basis of what can the steam generating unit actually produce and then add 15 per cent.

2. Selection of the fan wheel should be given very careful study, particularly as to design of blading, selection of materials to be used, ease of assembly, and dismantling, routine maintenance and repair, maximum of operating temperatures, normal operating tem-

THE *Preferred* FLANGED JOINT FOR WELDED PIPING SYSTEMS

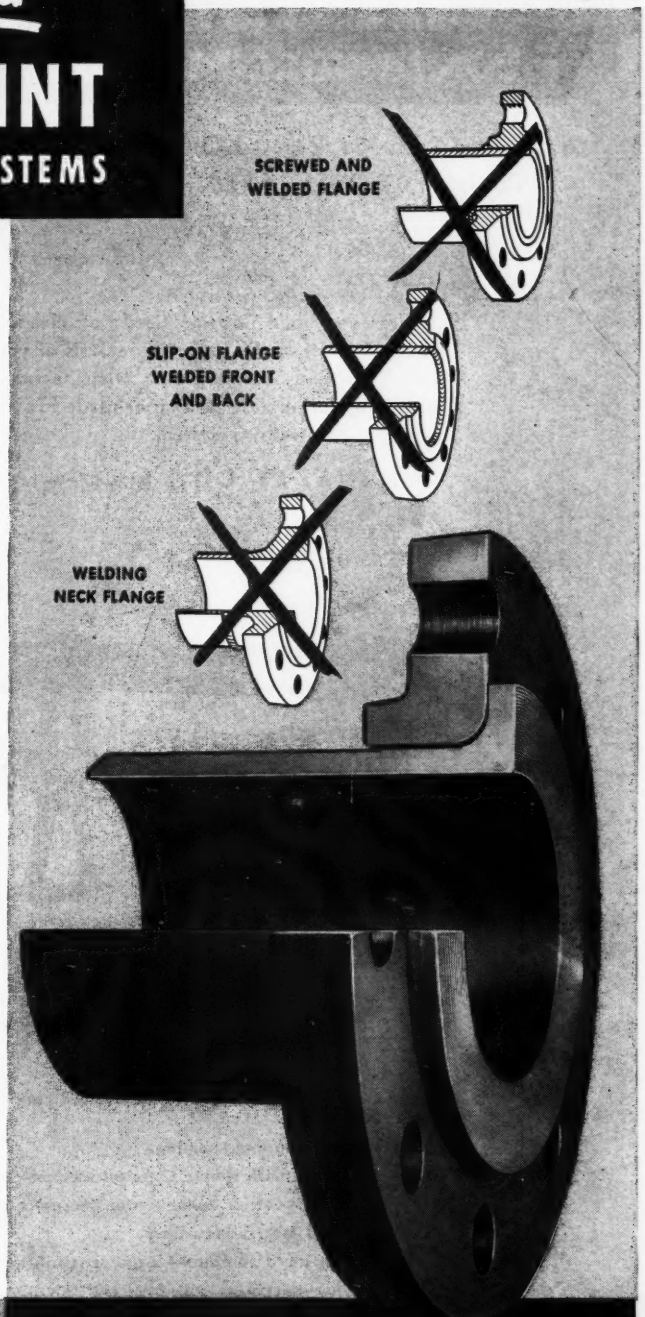
MIDWEST

LAP-JOINT STUB ENDS

For making connections to boilers, pumps, valves and other flanged outlets (and where piping must be frequently cleaned or inspected for corrosion), Midwest Lap-Joint Stub Ends have a tremendous advantage over flanges that are welded to the pipe (see drawings at right above). The swivel flange on the Stub End makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding.

Another important economy is in erection. Field organizations report a saving of 25% in erection time for making up a joint using Midwest Lap-Joint Stub Ends in comparison with flanges rigidly fixed to the pipe; this saving is even greater when the flanges are on bends.

See Bulletin WF-41 for complete data regarding Midwest Lap-Joint Stub Ends . . . and the many other Midwest Welding Fittings that simplify and save on welded piping.



MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Building.

MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS

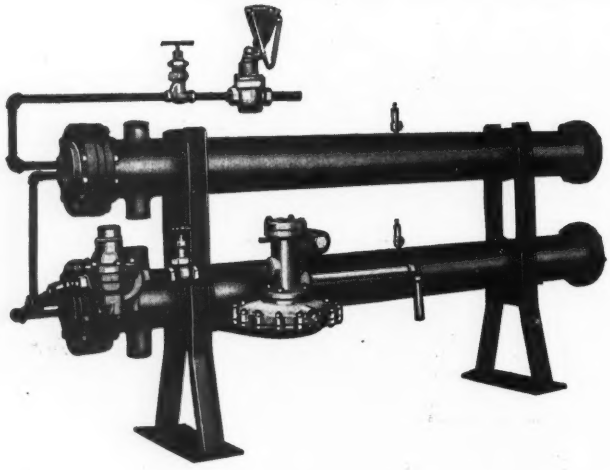
HENSZEY
CONTINUOUS BLOWDOWN

helps keep BOILERS and Other EQUIPMENT on the Job!

The Henszey system continuously and automatically keeps boiler water concentration below safe levels—and without heat loss!

Plan now for your postwar needs of clean, low-cost steam. We will gladly make an analysis of your boiler water problems to show you what savings can be made by installation of a tailor-made Henszey Continuous Blowdown System.

HENSZEY CO., Dept. C7, Watertown, Wis.



Check these **ADVANTAGES...**

- Produces clean steam — no carry-over.
- Saves up to 95% of the heat loss of ordinary intermittent blowdown.
- Prevents Priming and Foaming.
- Prevents Scale (with simple chemical treatment).
- Automatically Controls Boiler Water Concentration.
- Indicates and Meters Blowdown.
- Practical for any size plant — large or small.

HENSZEY

CONTINUOUS BLOWDOWN

Flow Indicators • Distillation Systems • Heat Exchangers

Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

peratures, special design of and material to be used for center plate construction in double type rotors, method of assembly of center plate to wheel hubs, and design of blading best suited to the specific job for which the fan is to be used.

Different fuels, type of fly ash, etc., have a bearing on blade design. In addition to fan blading design, a factor well worthy of consideration is the application of renewable wearing plate to the blade, so arranged to compensate for usual wear of the blading surfaces. This shielding can be made most effective from forming out of ⅛ in. to 3/16 in. ribbed floor plate fastened onto the blading by counter sunk head rivets, and then run a welding bead around all corners for purpose of sealing off the possibility of fly ash cutting in around this plate and the blading proper. (See Fig. 6.)

3. Wheel inlet cones should be made up of 3 or 4 equal sections of steel plate assembled in such manner that they can be readily removed for repair or replacement. Wheel and cone relationship should be such as to permit for expansion in axial direction.

4. Renewable scroll and side liners should be designed in such a manner that worn liner sections can be readily removed and replaced with minimum delay and expense. For scroll liners, side liners, duct and stack lining Gunite is practical and is certainly worthy of serious consideration. There is little question as to Gunite standing up under temperature ranges usually experienced with induced draft fan service. If Gunite is used for scroll liners in place of steel, it will be necessary for the fan manufacturers to construct the fan housing approximately 1½ in. larger on the radius than otherwise would be the case so as to provide space for Gunite linings, without cutting rated fan capacity.

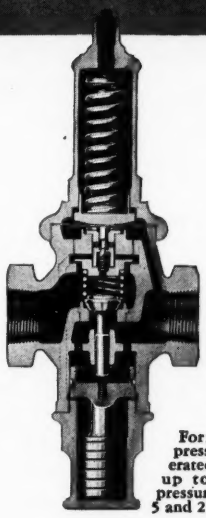
5. Fan bearings, thrust and plain, should be of the heavy duty, self aligning rocker type, and provided for water cooling if desired by the user. Such bearings should be provided with separate pedestals and separate sole plates.

The bearing shell and bearing should be assembled in such a manner that they can be readily removed and/or replaced without disturbing the bearing pedestal and the pedestal should be assembled in such a manner that it can be removed without disturbing the sole plate or bearing housing. The main steel sole plate should be

Masoneilan Regulators

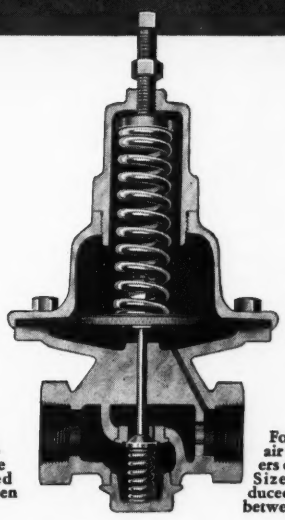
(For Steam, Water, Air)

HOLD PRESSURES WHERE YOU WANT THEM



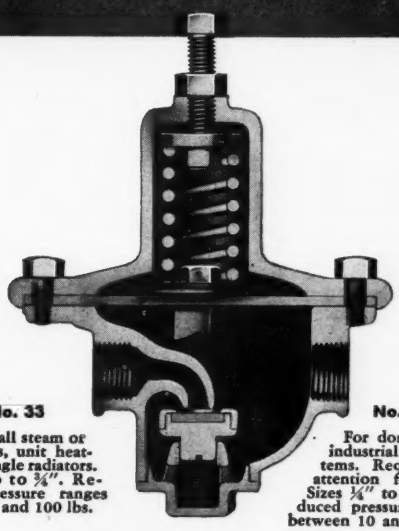
No. 11

For reducing steam pressures. Pilot operated. Sizes—bronze up to 2". Reduced pressure ranges between 5 and 225 lbs.



No. 33

For small steam or air lines, unit heaters or single radiators. Sizes up to ¾". Reduced pressure ranges between 2 and 100 lbs.



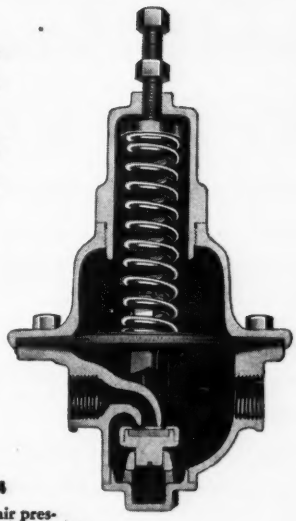
No. 227

For domestic or industrial water systems. Requires no attention for years. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.

In spite of fluctuating initial pressure or demand, Masoneilan reducing regulators hold pressures where you want them providing accurate, reliable and economical operation.

Their simplicity of operation and sturdy construction reduce waste, cut maintenance costs and assure long life under practically all types of operating conditions.

Some Masoneilan pressure regulators are now available for maintenance and replacements. We suggest you write for complete information and catalog 71.



No. 414

For reducing air pressure in industrial service. Also recommended for dead end service. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.

MASONEILAN STRAINERS

Prevent scale, dirt, chips, etc, from damaging regulators, traps, valves and pumps... use Masoneilan Strainers. These precision-made strainers keep out all foreign matter. They'll eliminate maintenance delays and save you money.

MASONEILAN

MASON-NEILAN REGULATOR CO.

1207 ADAMS ST., BOSTON 24, MASS.

New York Philadelphia Pittsburgh Tulsa Toledo Chicago Atlanta St. Louis San Francisco Los Angeles Houston

Mason Regulator Co. of Canada, Ltd., Montreal, Canada

Matched-Ground Bronze Seats give Dart Unions Longer Life

Here's why Dart Unions give you years of good service:

Dart's matched bronze seats, precision machined and ground to accurate "true-ball" surfaces make it possible for Darts to be used *again and again.*

Dart's tough Nuts and Bodies, made of heavy air refined malleable iron gives Darts their ability to resist rough handling and pipe strains.

That's why so many plants are looking for their old Darts . . . and putting them back on the job. In case you can't find any Darts around your shop, see your supplier for *new* Darts.

DART UNIONS LIVE LONGER

E. W. DART MFG. CO., Providence, R. I.

equipped with vibration dampeners so that bottom of bearing pedestal will rest on the dampening device. Water piping connections between bearings and piping should be made through use of flexible metallic hose and in no case piped up with solid connections.

Care should be exercised in liberal design of fan foundation work whether it be a steel structure or concrete or a combination of both. It is certainly worth the time and expense to carefully analyze a liberal use of vibration dampening devices once the base foundations are decided on. Skimpy fan foundation work and a fan operating out of balance can cause sufficient damage in a short time to pay for a lot of good work.

6. Induced draft fan drives and control usually fall within the range of the following:

(a) Constant speed drive, with damper control
(b) Constant speed drive, with vane control
(c) Variable speed and damper control
(d) Variable speed only. No secondary control
(e) Use of hydraulic and/or electromagnetic type of coupling control.

The subject of induced draft fan drives and control as briefly outlined above covers a wide range of engineering thought, i.e., steam turbine versus electric motor; variable speed versus constant speed; damper control versus vane control; etc. All are factors which each individual plant will have to decide on basis of best and most economical drive to suit requirements and as this paper was originated for prime purpose of dealing with the induced draft fan, a later paper may be written to cover the drives.

Power Plant Extension at Iowa Falls

(*Continued from page* 118)

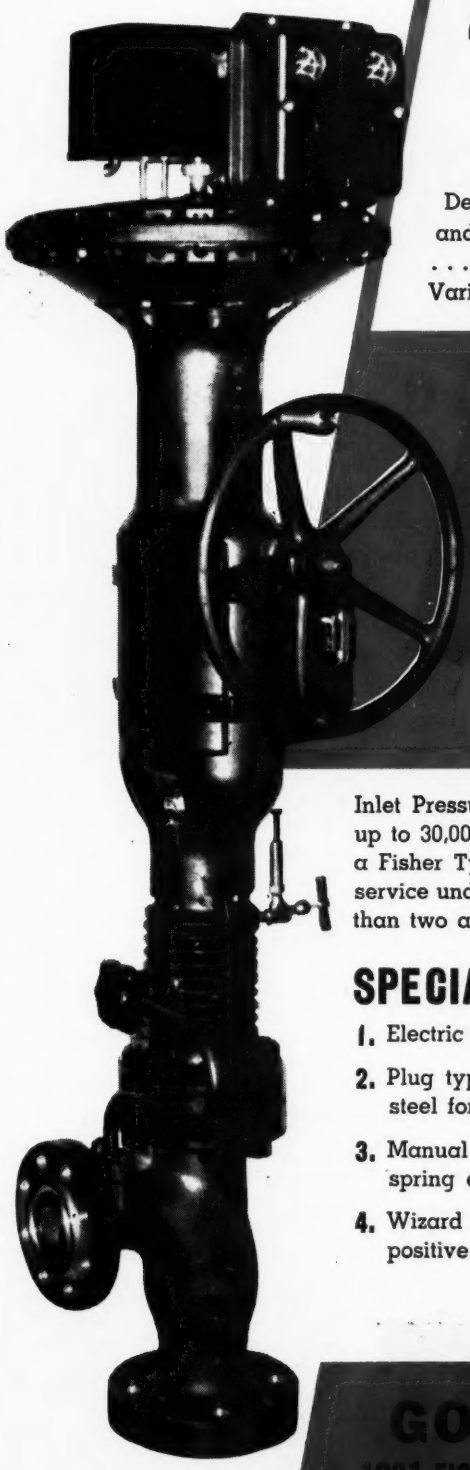
tically-divided, two-section unit, each section having its own circulating pump of 6000 gpm capacity. These pumps, however, are cross connected to supply either side or both. Hot-well pumps are provided in duplicate, with recirculating system for light load. The air removal system is the conventional 2-stage steam jet ejector.

The water treating system is somewhat unusual. Partially treated water from a lime and soda ash process is purchased from the Illinois Central Railroad Co. This water is then passed through

A TOUGH ASSIGNMENT FOR A PRESSURE CONTROLLER!

SOOT BLOWER SERVICE

Demands Specialized Pressure Control Equipment Designed and Built for High Pressure Drops . . . High Temperatures . . . Large Capacities . . . Intermittent Service . . . Highly Variable and Quick Changing Loads.



FISHER TYPE 461-4100 SB WITH MANUAL OVERRIDER CONTROL FEATURE FILLS THE BILL

Inlet Pressure — 1900 lbs.; Reduced Pressure — 750 lbs.; Capacity — up to 30,000 lbs. saturated steam per hour. That's tough service, but a Fisher Type 461-4100 SB has given dependable and uninterrupted service under those conditions in a large eastern power plant for more than two and one-half years.

SPECIALLY DESIGNED FOR THIS SERVICE

1. Electric cast steel sweep-flo angle body with finned bonnet.
2. Plug type single part inner valve and seat ring of 440 stainless steel for long life and prevention of sticking or galling.
3. Manual operator permits positioning of inner valve against full spring compression and/or full diaphragm pressure.
4. Wizard pilot assures sensitivity. Positioner provides fast and positive valve action. Both are integrally mounted.

FISHER GOVERNOR COMPANY

1021 FISHER BUILDING. MARSHALLTOWN, IOWA

★ Official United States Navy photograph. Interior of a submarine —a maze of piping.

Seamless steel tubes are the intestines of the ship, the power plant, the oil refinery, the locomotive, and the chemical plant...delivering an ever-flowing flood of power to America's mighty production efforts.

Seamless steel tube "know-how" is vitally necessary to keep those lines going steadily. Cold drawn seamless steel PTP tubing achieves accuracy to size and uniformity of gauge through exacting control and thorough inspection at every step in manufacture. Where cost is a factor, and seamless steel tubing required, PTP tubing offers an economical and satisfactory solution to the problem.

PIPE & TUBE PRODUCTS
INCORPORATED
Manufacturers of Cold Drawn Seamless Steel Tubing
JERSEY CITY, N. J. • WORKS: READING, PA.

Permutit filters, using a carbonaceous material to avoid the usual trouble of sand dissolving in the highly alkaline treated water and thus prevent troublesome silica deposits later on in the boiler and in the turbine blading. The purpose of the filters is to remove suspended lime material carried along in the treated water. The water is then passed to Permutit zeolite softeners using carbonaceous zeolite operating on the sodium cycle. The water then goes to the station surge tank and is handled from there by a surge tank pump to a Permutit deaerating type feedwater heater. Phosphate is fed directly to the boiler drum by a high-pressure chemical pump. This method of chemical feed avoids the precipitation of calcium phosphate in feed lines, control valves and tubes of extraction heaters.

The boiler feed pumps are in duplicate, one motor driven and one steam driven. These, together with the other miscellaneous drip, drain and house service pumps are furnished by Ingersoll-Rand Co. The steam driven boiler feed pump is equipped with a quick-starting General Electric turbine, so that in case of electrical power failure, this pump automatically comes into service.

The station auxiliary supply is furnished by a 440-v, 3-phase bus, one end of the bus being normally connected through a transformer to the turbine leads of the new unit, the other end of the bus being connected to the original 2300-v bus of the old power station section through a transformer. Automatic control equipment is provided so that, under "start-up" conditions, power is taken from the 2300-v bus, and after the main unit is brought up to speed and synchronized onto the 33,000-v bus, then the auxiliary power supply is furnished "running supply" by the new unit, all this transfer being done automatically.

The electrical gear, including motors for driving the auxiliaries, the auxiliary transformers, bus structure, switchgear and turbine switchgear, together with the transformer, are being furnished by the General Electric Co.

The new unit is tied to the 33-kv substation through a three-phase transformer rated 7500/10,000 kva, 13,200 to 34,500 v, equipped with hand-operated tap changers, which are provided with two 2½ per cent taps above and below normal. The switchgear is of the modern steel cabinet type.

LOST!
Somewhere along the line the company is losing thousands of dollars through leaky valves. Finder please notify Management.
REWARD

Let's do something about it THE DEXTER WAY!

Let's stop the valve leaks! They can really run into three-figure totals every month — besides costing man-hours and machine production and output spoilage . . .

Let's stop the valve leaks *without removing the valve from the line!* One or two men, with Dexter Valve Reseating Equipment can easily repair and *keep in repair* every globe, gate and pump valve, wherever a man can get at it. No costly breaking-out, no new parts needed, no delays for "factory repair jobs." And we furnish instructions so simple and complete that a man of ordinary intelligence can do the job correctly — *and quickly*.

Tell us about your most troublesome valve

Give us the make, type, size and material — the fluid handled and its pressure — and we'll quote you on the Dexter Valve Reseating Outfit needed to take care of it. One repair job has been known to pay for the Dexter Equipment — so write us today — don't delay.

10

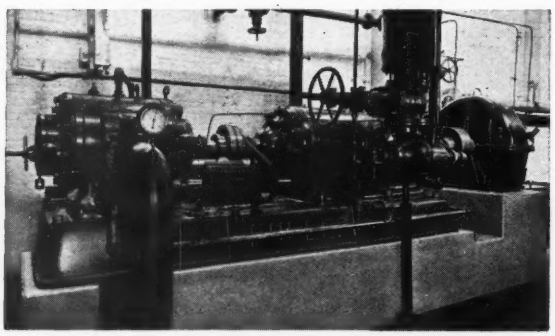
FOUND!
..by the Chief Engineer, who answered an ad in a trade journal and bought...

FOR GLOBE, GATE AND PUMP VALVES

DEXTER VALVE RESEATING EQUIPMENT

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

FULLER
ROTARY COMPRESSORS
for
ECONOMICAL AIR AND GAS COMPRESSION



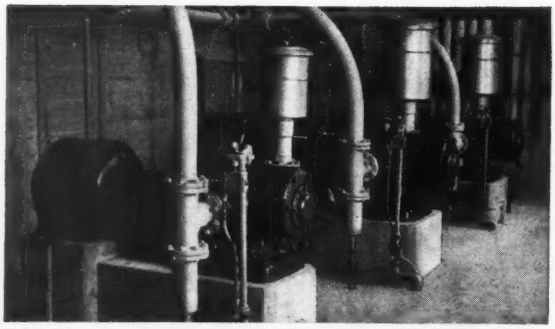
Two-stage compressor, geared-turbine drive. Capacity 1775 c.f.m., 100-lb. pressure.

For many years Fuller engineers have striven to build the best compressor money could buy . . . simple in design, rugged construction for long, continuous service at minimum operating expense.

Performance records show they're truly the economical unit . . . in a foundry $3.90 for repairs in three years; in a patent fastener plant after four years' operation: "It has run 23 hours per day almost continuously and has given no trouble." Not a cent was spent for repairs during this time. A plant engineer in a war industry writes: "It is now approaching the third year of continuous operation for your two-stage compressor, during which time we are glad to report that the service-load factor has been in the neighborhood of 99.9 per cent."

Fullers are built for capacities to 1800 c.f.m. actual free-air delivery, 125-lb. pressure.

Write for Bulletin C-5, illustrating and describing these machines.



Single-stage compressors. Two units, capacity each 763 c.f.m., 30-lb. pressure. One unit, capacity 320 c.f.m., 50-lb. pressure.

C-90

FULLER COMPANY
CATASAUQUA—PENNSYLVANIA
CHICAGO Marquette Bldg. WASHINGTON, D.C. Colorado Bldg. SAN FRANCISCO Chancery Bldg.

NDHA Reports Progress of Heating Utilities

Problems resulting from war conditions, technical developments in the industry, research projects under way, and present busines problems were discussed at annual meeting in Pittsburgh June 14 and 15

PRESENT AND POST-WAR problems confronting the district heating industry are many and varied as was evidenced by the subjects discussed at the Thirty-fifth Annual Meeting of the National District Heating Association held in Pittsburgh, Pa., on June 14 and 15. Reconversion, however, is not one of those with which the industry will be forced to contend, except as the customers of steam generating companies may have to change their requirements for service due to changes in their products. The industry's reconversion problem is simply one of supplying more or less steam for public consumption—a problem which is not new in any sense of the word.

This organization has developed a method of functioning very effectively through the work of standing committees that are given assignments of problems to study and report upon, many of which require and receive the cooperative effort of members of the Association in the collection of data on the various activities engaged in by district heating companies.

Among the first to report was the advisory committee which had some very definite recommendations to make for the purpose of securing wider recognition of the Association. A larger membership is desirable in order to promote progress of the industry and to this end these committees suggested the preparation and distribution of appropriate promotional literature on the benefits of membership in the Association. It is thought that news items regarding the activities of the Association should be more widely distributed among the trade and technical publications. A one-day forum held in the fall of each year given over to a round table discussion, was recommended. The need for education on materials used by manufacturers in the field was also pointed out.

Rates and Regulations

Rates and regulations that are in effect throughout the country are continuously under observation of the Association but this year it was reported that no new rates are contemplated since the various member companies are satisfactorily meeting competition with their present schedules. Termination of war loads is being felt in some localities but not generally and will present a problem when war production ceases completely, at which time rates will need adjustments. Sales and rates are recognized as going hand in hand and the future outlook is bright.

Another factor which effects rates for steam service is the load factor of the plant. The committee is making a study of the causes of and remedies for low load factors. It was suggested that

FUEL-OIL conservation is not a wartime measure for owners of Cleaver-Brooks steam generators. They practised it and benefited from it long before Pearl Harbor.

An average of one *less* tank-car of fuel-oil is consumed annually in hundreds of industrial plants because Cleaver-Brooks steam generators have replaced less efficient fuel-oil steam generating equipment in such plants. Every tank-car of fuel-oil is precious today and the hundreds so conserved are a substantial contribution to the nation's reserves.

Cleaver-Brooks steam generators are thrifty with fuel (thermal efficiency of more than 80%) because of the original and exclusive Cleaver-Brooks four-pass, down-draft construction of the boiler with its long fire-travel and especially designed burners.

Quick steaming capacity—minimum manpower needed for operation and maintenance—cleanliness, no smoke, ashes, clinkers—compact space saving design—simple low-cost installation—dependable performance are all added advantages.

Get complete information now—for the future—on Cleaver-Brooks steam generators—20 to 500 HP.; pressures 15 to 200 lbs.

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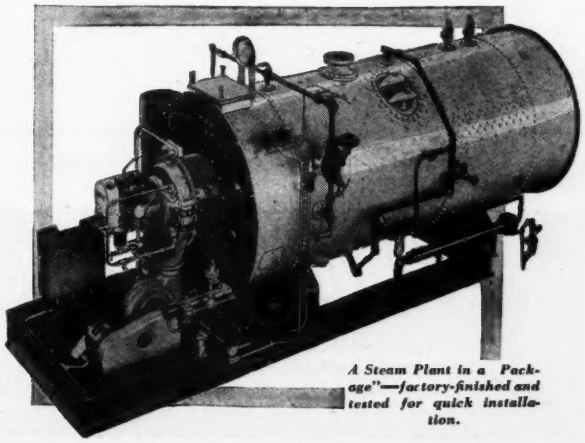
Send for our instant Steam Cost Calculator for figuring steam costs using coal or oil fuel. Yours for the asking.



A Steam Plant in a Package"—factory-finished and tested for quick installation.

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STEAM GENERATORS

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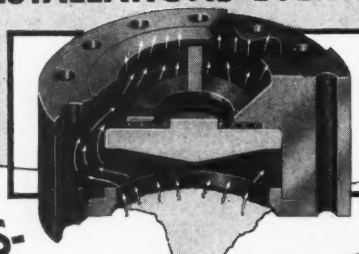
COSTLY, DESTRUCTIVE "WATER HAMMER"

WITH INSTALLATIONS EVERYWHERE!



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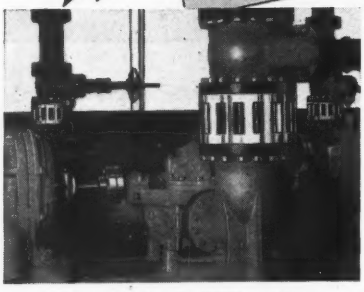
FLANGED Silent CHECK VALVES



Three 10"-300 lb. Williams-Hager Flanged Silent Check Valves in Radio City, N. Y.

Eliminates

Costly Breakdowns in Pumps and Piping Systems with Operating Pressures up to 6000 lbs!

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provides uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, salt water, brine, etc., etc., regardless of temperature.

Write today for interesting folder on "Water Hammer—Cause, Effect and Control in Piping Systems."

THE WILLIAMS GAUGE COMPANY

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rate adjustments to encourage steam use at off-peak periods may have a beneficial effect. The application of heat storage methods may be helpful if rates are made more favorable to the customer who will co-operate.

New applications of steam have developed during the war and it is hoped that many of these services can be continued in peace time. Load factors now range from 14 to 40 per cent throughout the country and it is thought that they can be built up by a study of the customers' needs and a carefully designed rate structure.

One of the first principles in rate making is to have a system that is easily explained to the customer so he can figure them out for himself. Emphasis was layed on the fact that district heating is a service industry and its value to the customer cannot be measured in direct proportion to the heat units delivered. The committee presented a carefully prepared analysis of present rate structures now in effect among member companies.

Sales Development

Since 1919 the business of the district heating industry has increased 600 per cent, according to the report of the sales development committee, and it is expected that the next 25 yr will witness a growth similar to that in the electrical industry from 1900 to 1925.

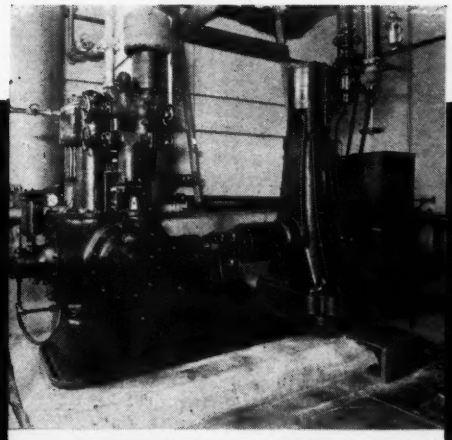
While the problem of unemployment in the heating utility industry during the immediate post-war period will present some difficulties, it will not be as serious as in the war industries. The committee recognizes, however, that full employment is essential to the healthy economic condition of the country and this utility expects to absorb its proportionate share of the unemployed workers during the post-war period.

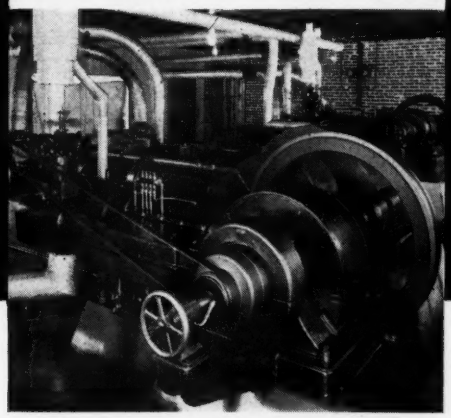
The Association is taking an active part in the work of the Committee for Economic Development (CED) formed by industrial leaders throughout the country to deal with post-war problems and it was indicated that war production has probably reached its peak and the period of industrial demobilization is approaching. Painful readjustments are in the offing with organized labor determined to battle mass layoffs. The problems of getting back to peace time production are being studied by CED representatives in all communities with the object of making as little disturbance in the economy of the country as possible.

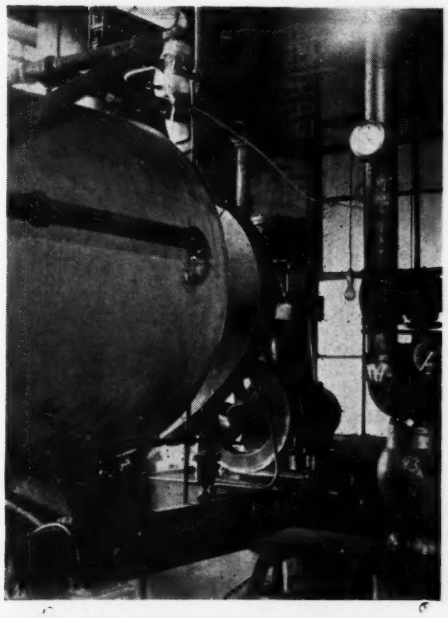
Among the problems soon to confront the country are the disposal of war plants, how to use or dispose of surplus war goods, the providing of full employment, the expanding of production in some factories to keep people at work, the coordination of production of goods and needs of the public. Through CED, American business men are planning for all American industries and are seeking government co-operation.

The committee described experiences in Boston in regard to connecting new load and plans for holding it in the postwar period. It was pointed out

THERE'S A VALUABLE "BY-PRODUCT" IN YOUR STEAM!







THE steam that your plant uses for heating, processing, and other low-pressure service, may be a source of an important *by-product* . . . power.

If that steam is piped directly from the boiler to its heating job, through a reducing valve, you are throwing away power. Put in a Troy-Engberg Steam Engine and recover this power; use it to drive a blower, compressor, dryer, or some other processing or power plant equipment.

Sometimes the entire cost of a Troy-Engberg Steam Engine is written off within a year; frequently, within two. Look into the advantages of economical by-product power (and dependable power, too) as offered by the Troy-Engberg Steam Engine.

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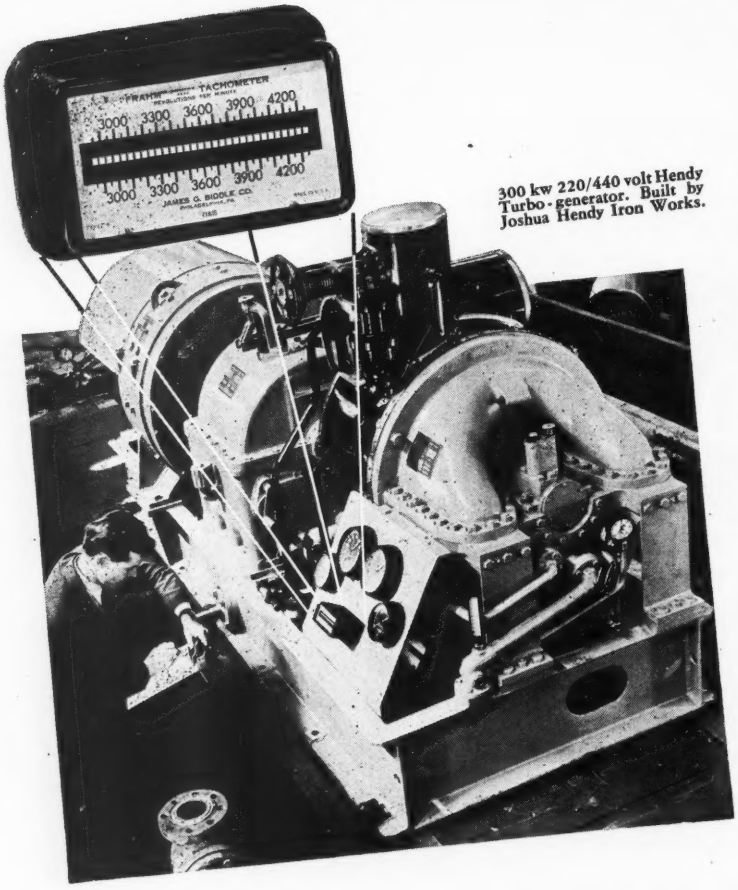


300 kw 220/440 volt Hendy Turbo-generator. Built by Joshua Hendy Iron Works.

. . . making **"ASSURANCE DOUBLY SURE"**

***with the* "FRAHM" RESONANT-REED TACHOMETER**

In the modern turbo-generator, uniformity of speed must be maintained over the entire range of no-load to overload conditions.

The Hendy unit shown above has a carefully designed and precisely built governor to assure uniform speed under widely varying load conditions. As a double check, however, Frahm Resonant Reed Tachometers are used on Hendy and other well-known turbo-generators, both large and small, to provide the operator with constant proof of turbine speed. Manufacturers select Frahm instruments for this service because of their simplicity of construction, ease of installation and freedom from maintenance.

Frahm Tachometers are built in both stationary and portable types for use on many kinds of machines having rotating parts. Various ranges are available from 900 to 60,000 r.p.m.

For a complete description of Frahm Tachometers together with list of types and ranges commonly supplied, write for Bulletin 1590-PE.

JAMES G. BIDDLE CO. 1211-13 ARCH ST. PHILADELPHIA 7, PA.

that fuel oil scarcity had forced many customers to use district steam which added an estimated 35 per cent to the load.

In the report on plans, it was stated that the annual sales of the industry amount to $40,000,000. Individual planning is imperative due to the diversity of local problems. The opinion of some in the industry is that business lost during the reconversion period will be taken up by new business. Air conditioning and tire retreading are fields which offer unexplored possibilities for steam loads; better heat control equipment will benefit the industry. Few companies are conducting research at the present time.

Use and application of steam in industry presents many problems to the user, the sales development committee brought out, and the steam utility engineers could make many customers friends by helping to solve these steam-use problems. Competition between the utility and isolated plants in buildings is live and reported as becoming more active, calling for more sales promotion on the part of the utilities.

Commercial Relations

In the more technical side, the commercial relations committee submitted data by means of which it is possible to calculate the sizes of economizers and condensate coolers required for specific services. Mathematics may be avoided, however, by the use of the charts which were presented.

Report was made on a survey which was recently conducted to determine the steam consumption for water heating in various types of buildings. Among those upon which data were given are office buildings, theaters, restaurants, parking garages, hotels, resident clubs, and YMCA's, and department stores. The methods of measurement were outlined in the report.

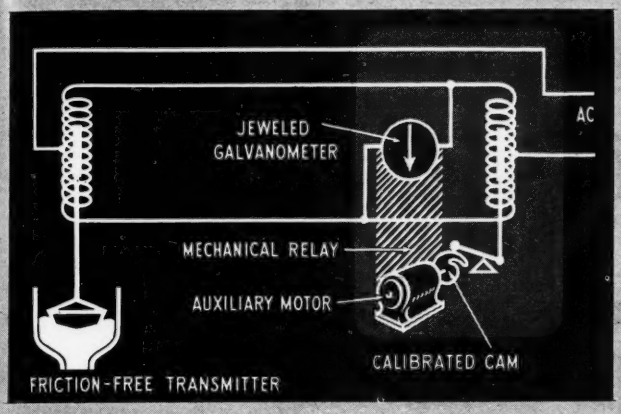
The committee also submitted a description of a temperature control system for water in a storage tank of a dry sprinkler system, together with results and savings obtained by its installation. The thermostat was set to turn on steam when the temperature of the water dropped to 42 F.

Operating Statistics

Trends of those systems reporting annually to the operating statistics committee were presented graphically covering a period of ten years. The systems were divided into five groups according to their annual sales in pounds of steam. The graphs presented included total annual steam sold, average revenue, total number of customers, total connected equivalent direct radiation, total cubic feet of space served, and distribution system efficiency. The entire group of graphs shows not only a growing industry but one that is making definite improvement in its operating methods.

Research

During the past year the research committee undertook the study of three problems, the results of which were reported at this meeting: the correlation of steam use in buildings, use of district steam in certain types of

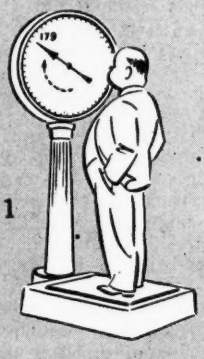


In the Cochrane Flow Meter, the Null or Zero Balance principle is employed, balancing the unknown quantity by adjusting a known quantity of the same kind. A highly sensitive detector is used to determine the point of balance. A friction-free transmitter serves as a pilot for an external motor drive. The motor restores the bridge to balance and operates recording pen, indicating pointer, and integrator. The measuring circuit is relieved of all work.

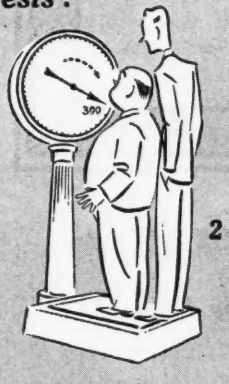
—

NO HYSTERESIS...NO FRICTION LAG

What is Hysteresis?

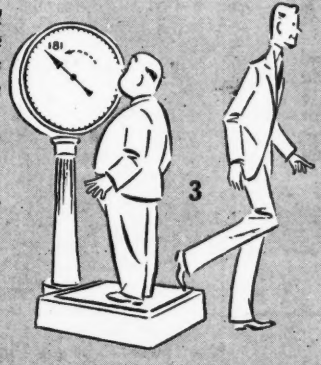


1. Let's say you actually weigh 180 pounds. When you step on the platform spring scales in the drug store, the pointer goes up fast until it approaches 180. The movement becomes slower and slower, the pointer finally stops at 179.



2. Now you try it again but this time another man steps on the scales with you, your combined weight registering 300.

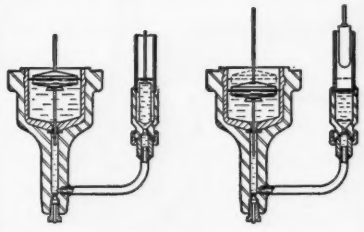
3. Then your friend steps off and the pointer comes down from 300 and gives your weight now as 181.



The discrepancy results from approaching the balance point from opposite directions with a deflectional system. Exact balance is never attained. "Hysteresis" is the word for it.

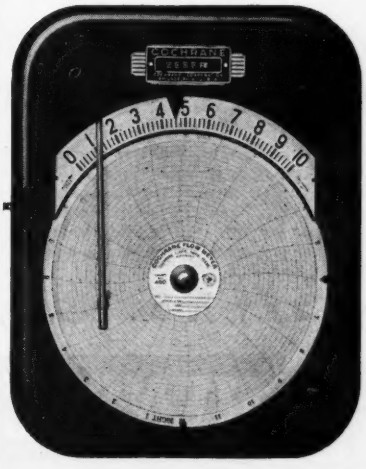
Accuracy
Quickly Checked

In less than five minutes, a Cochrane Flow Meter, from mercury level clear through to the pen record can be verified as to accuracy. The check is made at 20 per cent of meter capacity after the meter has been checked at zero by means of the simple zero adjusting screw in the receiver.

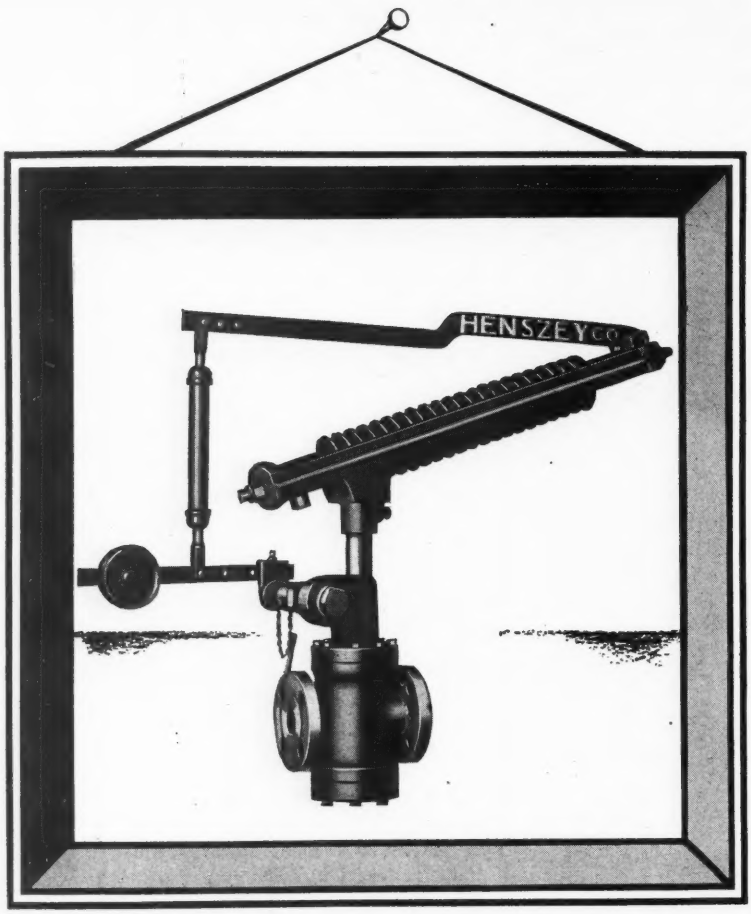


As shown above, when the calibrating rod of the transmitter is raised, the mercury surface is lowered, thus causing the float to assume a position corresponding exactly to a 20 per cent rate of flow. Compare this easy method with the clumsy, inconvenient water column method.

COCHRANE CORPORATION
3123 N. 17th St., Philadelphia 32, Pa.



COCHRANE FLOW METERS



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Let this "worker" watch your boiler!

Control boiler water levels continuously and accurately under ALL LOAD CONDITIONS with

HENSZEY Boiler Feed REGULATORS

These units are as easy to install as a gate or globe valve—no additional supports needed—they go right in the line. Once installed and set for operation no further attention is necessary—nothing to rust—nothing to get out of order. When the boiler needs water the Henszey Regulator delivers it—just enough to bring the water back to the proper, efficient level. Made for pressures up to 600 lbs. and in sizes up to 4 inches. Send for bulletin giving details.

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BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

air conditioning and degree-day standardization.

In the study of steam use, nine types of buildings were investigated: churches, department stores, lofts, residences, commercial, clubs, apartment houses, hotels, and restaurants. As a result of this study, the committee recommends that estimates of heating requirements be based on exposed area calculations, and that volume comparisons be dropped.

Work on the standardization of the degree-day is being carried on in cooperation with other interested societies and it was reported that an instruction book on the use of the degree-day method of estimating heating requirements is now being prepared by the U. S. Weather Bureau.

Chemistry

Corrosion in pipe lines is the principal problem which has occupied the attention of the chemistry committee and research work is still in progress on the causes of CO_2 in condensate and methods of preventing corrosion due to its presence.

The U. S. Bureau of Mines has been confronted with this corrosion problem in a number of the army camps throughout the country and its studies on the use of amines in the control of corrosion in steam heating systems were described as part of the committee's report. Also included were some of the results of corrosion research work.

Steam and Engineering

Reports presented by the steam station engineering committee were confined to analysis of the present fuel situation with a plea for conservation by every means possible to prevent a serious shortage during the coming winter, and a study of stoker fuel beds aided by the presentation of a colored moving picture film showing in slow motion the changes that take place in a bed of burning coal.

Steam Distribution

In the report of the distribution committee detailed discussions were presented on a number of problems that have confronted members of the Association. Solid pour construction for steam main conduit was discussed with the conclusion drawn that a good job may be had if proper precautions are observed.

Among other topics discussed by the committee were: methods and practices used for lengthening the life of underground steam lines; cell concrete enveloped; experience with diaphragm-operated relief valves; the installation of 1000 ft long temporary high pressure main to an industrial user; and electrolysis of underground steam mains.

Meters and Accessories

Past and present practices and contemplated changes in the inspection, testing, and reading periods of steam or other routine operations occasioned by the shortage of labor were summarized in the report of the meters and accessories committee.

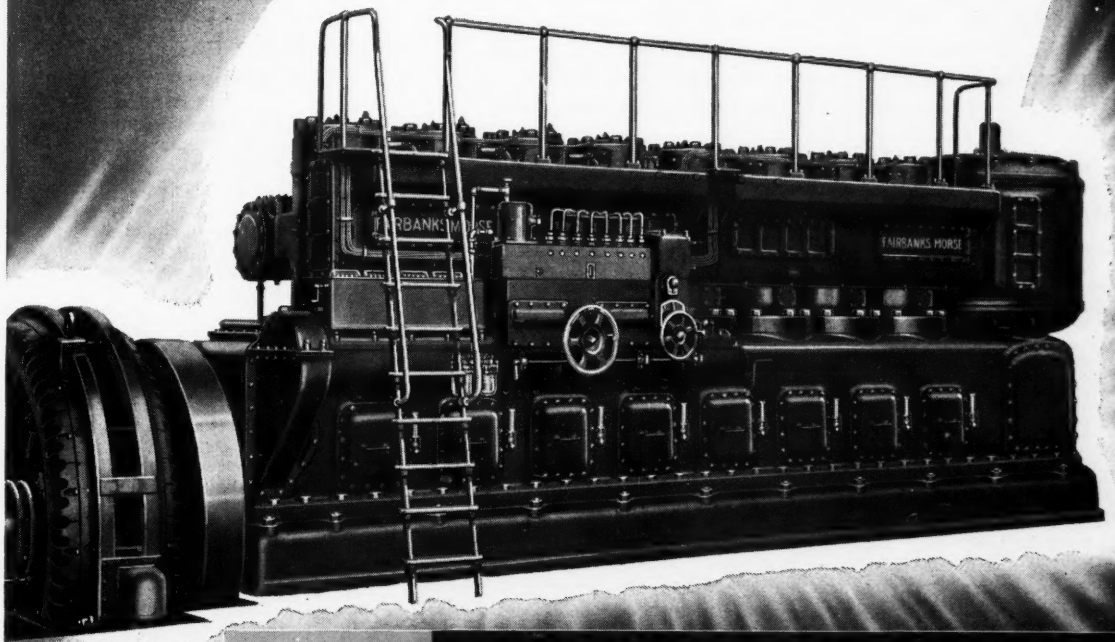
A description was also given of the changes made in the practice of testing and maintaining condensation meters in

Staying POWER!

Fairbanks-Morse Diesels have staying power . . . the ability to deliver low-cost, dependable power continuously—year after year . . . and with consistently low fuel and maintenance costs.

Designed and built on the 2-cycle principle—Fairbanks-Morse Diesels have fewer moving parts to wear—and less wear on those because of slower operating speeds.

If you need more power or lower-cost power, have a Fairbanks-Morse engineer study your problem. There is no obligation. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois. Branches and service stations throughout the United States and Canada.



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Diesels

It SPOTS WASTE While it WEIGHS

. . . One Way A RICHARDSON Automatic Coal Scale Saves Fuel and Money

With the aid of a Richardson Automatic Coal Scale, you can quickly pick out the coal-wasting boilers in a battery . . . remedy what's wrong *before* fuel and money are lost.

Used as units of a Richardson Coal Weighing and Feeding System, these scales accurately and indisputably record the weight of coal consumed by individual boilers; indicate uniformity of load carried by multiple pulverizers serving a single boiler.

A patented Richardson feature for stoker installations is the "Monorate" Non-Segregating Distributor. A reduced section down its center improves on flat spouts, permits uniform velocity throughout. Since lumps do not turn, the cause of segregating coarse and fine lumps is removed.

Bulletin No. 1143 is packed with helpful facts and pictures. It contains forty-five pages of technical details, photographs and diagrams of installations showing Richardson systems in operation. Send for your copy.

RICHARDSON SCALE CO., CLIFTON, N. J.

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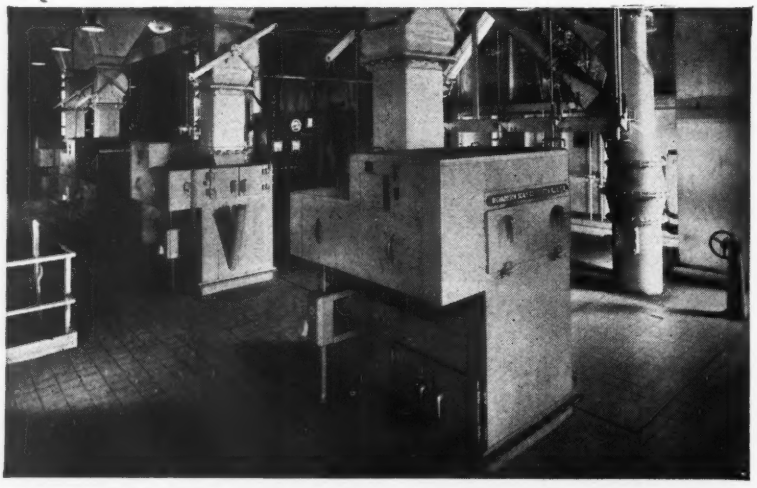


A battery of Richardson Coal Scales in operation. Equipment is compact, dustproof and needs no special attendant for continuous day and night weighing and materials handling.

5767

Rochester, N. Y., due to war conditions. Also described were the effects of testing condensation meters biennially or triennially instead of annually on meter accuracy.

New Officers

At the final session of the two-day meeting the officers were elected and installed. These are as follows: president, S. S. Sanford, The Detroit Edison Co.; first vice-president, R. M. McQuitty, Union Electric Co. of Missouri; second vice-president, John F. Malone, Consolidated Gas, Electric Light & Power Co.; third vice-president, Robert D. Martin, New York Steam Corp.; secretary-treasurer, John F. Collins, Jr., 827 N. Euclid Avenue, Pittsburgh, Pa.; executive committee, J. J. Schenk (immediate past president), Rochester Gas & Electric Corp.; L. W. Loucks, Allegheny County Steam Heating Co. of Pittsburgh; and Henry Martin, Boston Edison Co.

ASME Nominations for 1945 Officers

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS has announced the following nominations for the 1945 officers of the Society: Alex D. Bailey, Vice President of the Commonwealth Edison Co., Chicago, is the nominee for President; for Vice President: David Larkin, John E. Lovely and Thomas S. McEwan; for Managers: Daniel S. Ellis, Arthur J. Kerr, and Herman George Thielscher. Election of the nominees will be held by letter ballot of the entire ASME membership, closing September 26, 1944.

A Tribute to a Great Engineer

June 20, 1944

THIRTEEN years of intimate association with Geo. A. Orrok, engineer, have been an experience of rich and lasting value. My appreciation and gratitude for those years, so full of professional inspiration and warmest friendship, can only be exceeded by my daily sense of loss in the passing of "Uncle George."

To have enjoyed this long period of closest association with an engineer of his international reputation and high and generous character, was indeed a rare privilege, and one never to be forgotten.

Much has been published regarding his professional life, and his record of extensive and versatile accomplishment. There has not been the slightest exaggeration in any of these accounts, which are a source of pride to his astonishingly large number of friends and acquaintances in the many countries of the world where his work and personality were so favorably known.

I need add nothing to all of this, but as his professional associate and close friend, I desire publicly, to express my admiration and respect for Geo. A. Orrok, and to contribute these few words in honor of a great engineer, a true gentleman, and a very dear friend.

DAVID MOFFAT MYERS

Philadelphia

AIRKOOLED

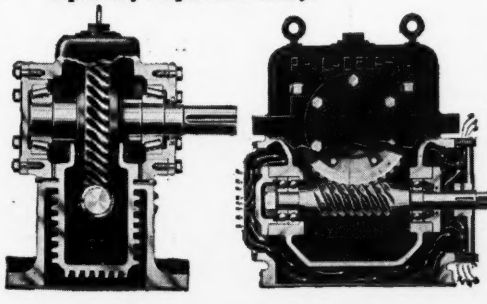
Worm Gear Speed Reducer

MORE LOAD CAPACITY
MORE COMPACT
Less Weight • Less Space

The New Philadelphia AirKooled Worm Gear Speed Reducer offers considerably greater horsepower ratings than the standard heavy duty type unit for worm speeds of 580 to 1750 RPM. At 1750 RPM, the ratings are approximately doubled at all ratios.

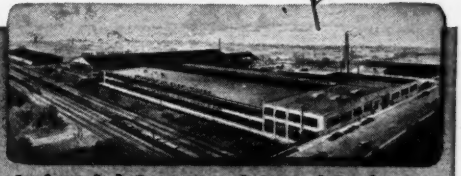
Horsepower ratings of standard worm gear units at higher worm speeds are limited due to the rise in temperature of the oil bath. The AirKooled unit dissipates this heat by drawing cooling air through the double walled ribbed housing with a suction fan mounted on the worm shaft.

At 1750 RPM, where the rating advantage is greatest, the AirKooled unit will be about two sizes smaller than a standard unit of the same capacity, resulting in a great saving in space and approximately a 40 percent reduction in weight. This saving in critical materials is especially important today.



Sectional Views showing double walled construction, direction of air circulation and fan mounted on worm shaft.

Send for Bulletin 250 . . . on your Business Letterhead



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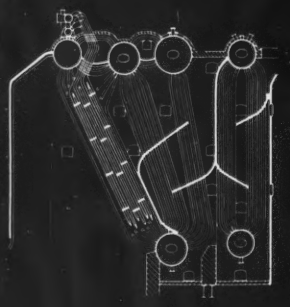
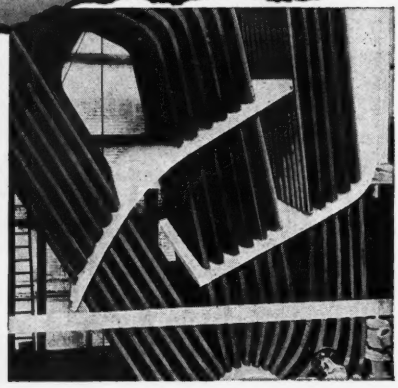
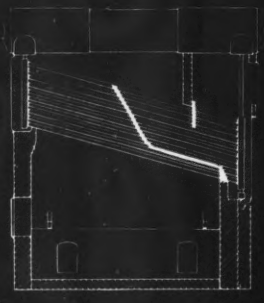
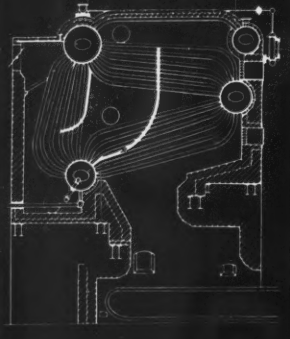
GET MORE STEAM by Streamlining









Streamline the cross-flow of gases over your boiler's heating surfaces and you increase steam output. It's as simple as that with Enco Baffles installed in your boilers.

Scientifically tapered gas passes and curved baffle surfaces put every square foot of heating surface to work, maintain efficient gas velocity, eliminate bottlenecks, eddy currents, dead gas pockets.

Draft losses reduced. Less steam needed for cleaning, because soot blowers work more effectively—and need be used less often with Enco Baffles.

Applicable to any design of water-tube boiler, fired with any type of fuel. Every installation individually designed on the basis of 25 years' experience in this highly specialized branch of engineering. Installed by skilled mechanics, using selected materials.

Write for **BULLETIN BW40**

FREE

Gives important data on modern baffle construction

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

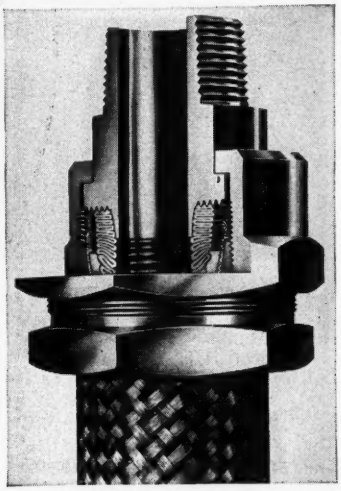
NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Metal Hose Coupling

FOR HELICAL flexible metal hose in sizes from ¾ to 1½ in., a detachable brass coupling has been developed by Packless Metal Products Corp., New Rochelle, N. Y., offering the advantage of being mechanically self-sealing at test pressures up to 800 psi.

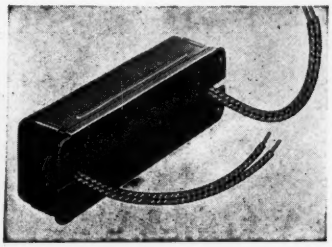
The unit consists of the nut, back, stem and split ring, and when assembled the convolutions of hose and the metal braid are securely held by pressure between the members as shown in the accompanying cut-away view.



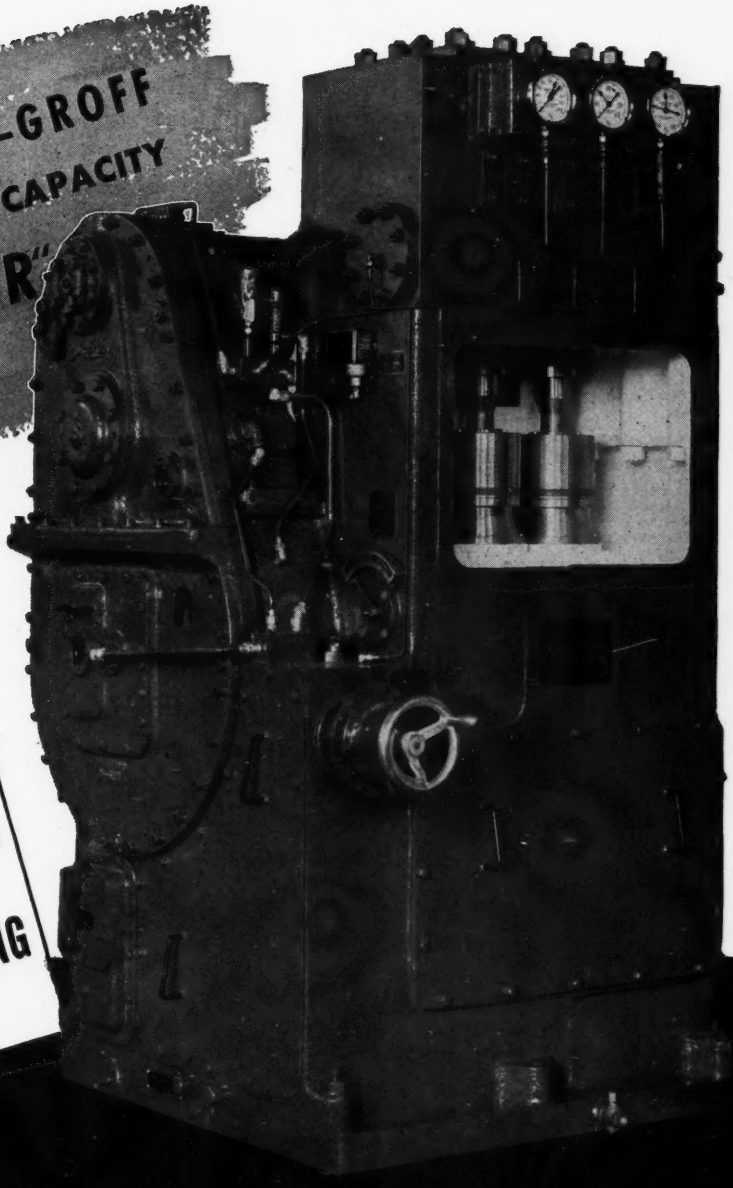
A feature of design is the self-contained union which permits the pipe thread end of the coupling to be screwed directly into the machine fitting and the union tightened without twisting the hose. This coupling can be re-used repeatedly and is easy to assemble with ordinary shop tools.

Ballasts for Instant-Starting Fluorescent Lighting

A NEW high-voltage, Tulamp ballast, for the operation of new 40-w instant-starting fluorescent lamps, has been announced by General Electric Co. It applies 450 v to the lamp at starting, striking an arc between the lamp cathodes, and thus eliminating the need for separate starter equipment. The ballast is now available in Tulamp 40-w ratings for use on 118-v circuits.



THE ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMP . . .



. . . for MAIN BOILER FEED and DESUPERHEATING SERVICE

Aldrich-Groff Pumps provide for automatic or remote manual control of delivery, from zero to full capacity, at constant pump speed. Rate of delivery is controlled by varying the length of the plunger stroke, and power consumption is almost directly proportional to pump delivery. These pumps combine the positive displacement and high efficiency of the plunger type pump with the flexibility and smoothness of a centrifugal.

The use of these pumps with unit feed systems eliminates the pressure and power losses associated with throttling-type feed-regulating valves. They provide advantages of feed system simplicity, efficiency and mechanical reliability for the small and medium boiler plant using medium and high steam pressures, and for de-superheater feed service in even the largest power stations. Over 100 units in operation on land and sea with outstanding service records.

Write today for the Aldrich Bulletin 65. It gives full details, sizes and ratings of Aldrich-Groff "Powr-Savr" Pumps.

THE ALDRICH PUMP CO. ALLENTOWN, PENNA.

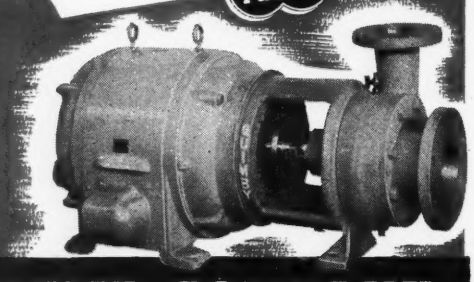
Announcing

QUIMPACT

the New Quimby Close-Coupled Centrifugal Pump

QUIMBY PUMPS

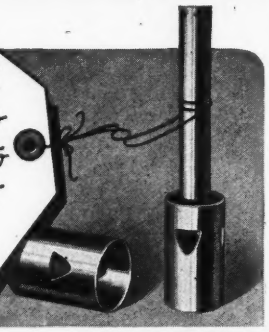
- Compact, rugged, efficient, low cost.
- Hydraulically and mechanically balanced.
- Double volute construction on larger sizes to eliminate shaft deflection.
- Adjustable foot under pump frame supports pipe loads.
- Sealed shaft sleeve protects entire shaft extension.
- Sizes 1 in. to 6 in. for capacities to 1000 GPM, heads to 450 ft., temperatures to 300°F.



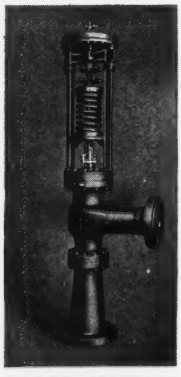
QUIMBY PUMP COMPANY
INCORPORATED

Division of H. K. Porter Company, Inc.
Pittsburgh, Pa. • Blairsville, Pa.
Newark, N. J. • New Brunswick, N. J. • Mt. Vernon, Ill.

"Swartwout certainly knows how to build the internal valve parts of their pressure reducers to stand up against wear, and to build the whole valve so it isn't noisy." A Chief Engineer



That statement refers to Swartwout Valves operated seven years without a penny of maintenance expense . . .



● Dependability you can bank on is built into every piece of Swartwout Equipment. You save on maintenance, and enjoy continuous trouble-free operation. Swartwout engineers gladly discuss your needs with you or your consultants. *The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio*

Swartwout POWER PLANT EQUIPMENT

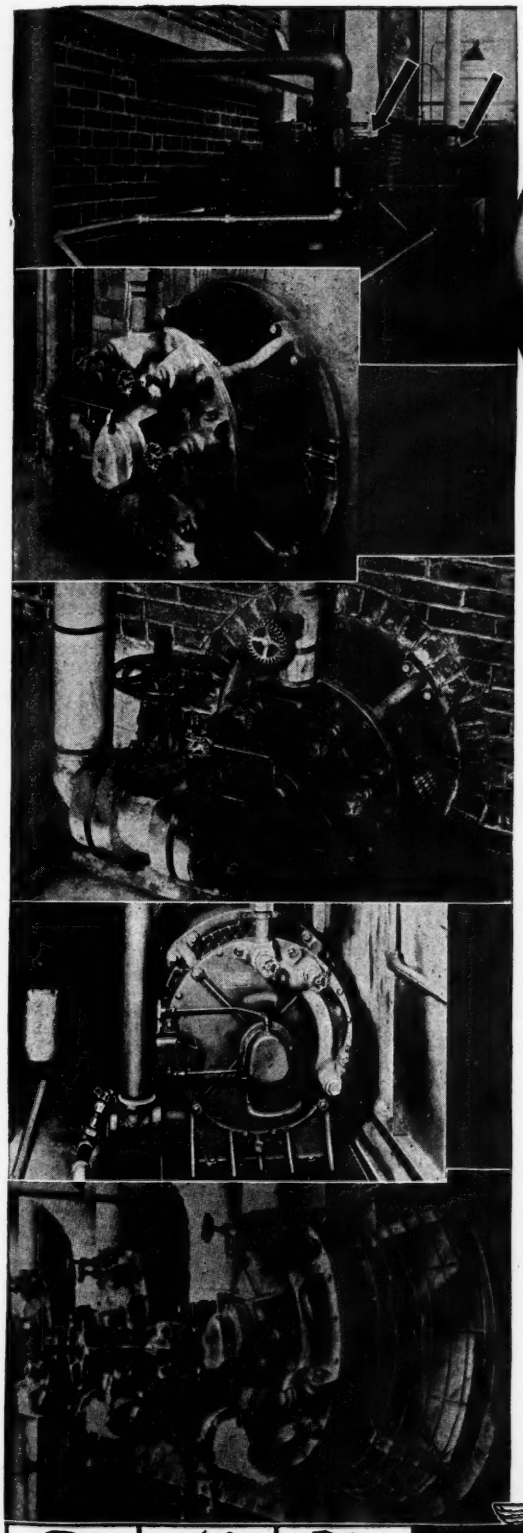
The ballast delivers rated watts to the lamp at nominal circuit voltage. Uniform light output is closely maintained even when the circuit voltage varies within the recommended operating range. Power losses are greater than in the conventional preheat ballast circuit.

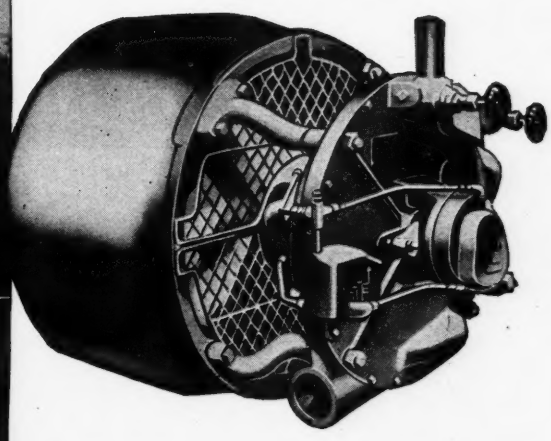
Like all other G-E Tulamp ballasts, this design provides high power factor, and gives excellent correction of cyclic light flicker. Special filters for suppression of radio interference are incorporated. The ballast is housed in a universal case that allows the leads to be brought out either the end or the bottom, permitting great flexibility of installation and complete utilization of present fixture designs.

Cochrane Rotameters

IN ANNOUNCING Series R-100 Rotameters, Cochrane Corp. of Philadelphia, lists several important features which are claimed to be exclusive. These meters are of the indicating area meter type, covering sizes from ⅛ to 3 in., with both free and guided floats. Floats may be viscosity or density compensated. Metering tubes are of extra heavy wall Pyrex borosilicate glass formed on mandrels, annealed, polariscope inspected and check-gaged by precision ball test.

Features include: Spring stop floats, to prevent damage to float by sudden surges of liquid; high pressure stuffing boxes, permitting use of corrosive liquids under high operating pressures; single external adjustment of stuffing boxes by wrench, instead of taking up successively a number of bolts or screws; white-backed metering tube for easy reading; interchangeable calibration scales for quick and inexpensive change from one service to another; constant tension guide rod is anchored in ends of glass tube instead of in end fittings. It can therefore be more accurately centered and its tension will be unchanged by repeated stuffing box adjustment; for test accurate work, guide rod can be supplied with spring loading feature to secure ideal precision of alignment.





TURBINE BLOWERS

AVAILABLE FOR QUICK DELIVERY

NO WAITING FOR ELECTRIC MOTORS

WING BLOWERS for Forced Draft are made for motor drive as well as for turbine drive. But the production of electric motors is temporarily one of industry's bottlenecks and motor-driven blowers (Wing's as well as other makes) are subject to greatly deferred deliveries. WING TURBINE-DRIVEN BLOWERS, however, are available *NOW,* with all the advantages of the turbine drive in addition. They are compact . . . simple to install . . . quiet in operation . . . and have a unique record for unexcelled reliability and efficient performance. In many plants where use can be made of the oil-free exhaust from these turbo-blowers the operating cost is negligible and the forced draft obtained at minimum cost—vastly lower than motor drive.
Write or wire today.

L. J. Wing Mfg. Co.

64 Seventh Ave. **New York 11, N. Y.**
Factories: Newark, N. J. Made in Canada at Montreal

Boiler Tube Expander-Driver

INVINCIBLE TOOL Co., Empire Bldg., Pittsburgh 22, Pa., has developed an angle tool attachment known as the Invincible Boiler Tube Expander-Driver which provides the link between the tube expander and the driving unit, making it easy to get at hard-to-reach spots.

These tools work in right or left-hand corners and are made in two standard sizes with ¾ and ½ in. square driving chuck. A special ball thrust take-up takes the thrust both forward and reverse, making for smooth, free-running operation. All thrust action is taken directly on these bearings, allowing instant reversal of driving direction. These tools are built for heavy-duty service, can be used on or off nuts, studs and bolts in tight spaces, and are obtainable in square or hexagon spindles and square, hexagon or Morse Taper shanks. Special models can be designed to meet individual requirements.

WILSON TUBE CLEANERS

For every kind of deposit and tube

Modern tube cleaners for every size and type of power boiler and for all kinds of deposits from the hardest to the softest, from the thickest to the thinnest.

wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

MANUFACTURERS' NEWS

At a recent directors' meeting of The Marley Co., Inc., cooling tower manufacturers, Ray T. Jenkins and Joseph A. Cameron were elevated to vice-presidencies. Mr. Jenkins, now general sales manager at the main offices in Kansas City, Kansas, is succeeded as director of the company's Houston division by Joe T. McKinley. Mr. Cameron continues in charge of the Eastern Seaboard division with offices at 2 Rector Street, New York.

Worthington Pump & Machinery Corp. has purchased Electric Machinery Manufacturing Co., Minneapolis. Major products of the company are synchronous motors for direct drive for power-plant and industrial machinery and electric generators for steam and internal-combustion engines, providing a logical expansion of Worthington's power and industrial-equipment lines.

Electric Machinery will maintain its executive personnel: Mr. Walter H. Feldmann, president, O. A. Soderstrom, vice-president in charge of manufacturing, R. H. Olson, vice-president in charge of sales, and Fred W. Hotchkiss, secretary and treasurer. It will operate independently of other Worthington activities.

The Edward Valve & Mfg. Co., Inc., has appointed Herr-Harris Co., 545 William Penn Place, Pittsburgh, Pa., to represent the company in the Charleston and Central West Virginia territory. The Herr-Harris organization has represented this company in the Pittsburgh area for 25 yr.

Warren Steam Pump Co., Inc., Warren, Mass., announces that the present manager of their Boston office, 75 Federal St., Howard C. Fiske, 45 yr with the company and the longest in service among their employees, will retire but remain a Director, an office held by him since 1926. He will be succeeded by Parkman A. Collins, associated with him for many years. Associated with Mr. Collins will be Harold Fox who has been with General Electric Co. since 1927.

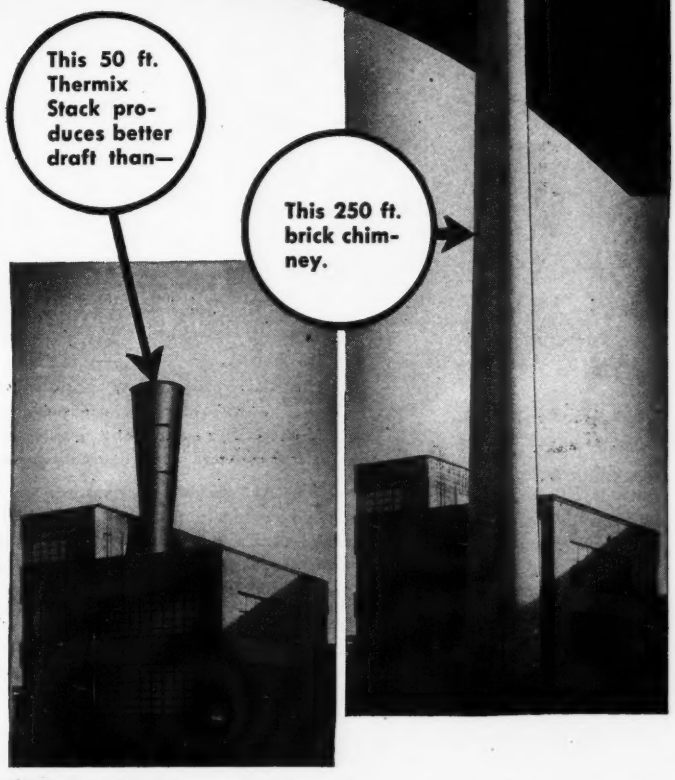
Frank W. Bemis has been appointed Sales Manager of the American Cable and Hazard Wire Rope Divisions of American Chain & Cable Company, Inc., with headquarters at 230 Park Avenue, New York. Mr. Bemis has been with the company since 1938.

Fisher Governor Co., Marshalltown, Iowa, has announced the appointment of Johnson and Scott as its sales representative in Memphis, Tenn. Territory to be handled includes parts of Kentucky, Tennessee, Missouri, Mississippi and Arkansas—all adjacent to Memphis. The appointment became effective April 10 and offices have been established in the Dermon Building, Third and Court, Memphis.

The McClave Co. of Allentown, Pa., manufacturers of McClave stokers and grates announce certain changes in their sales offices in the Pennsylvania territory.

For nearly 60 yr this company has had continuous sales representation in the Philadelphia Metropolitan Area

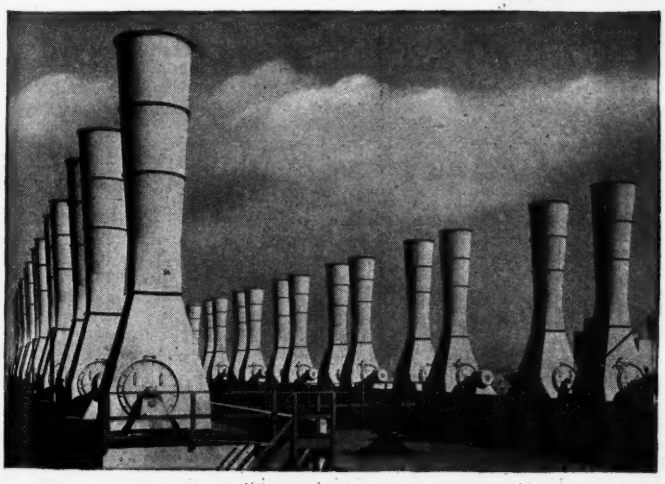
SAVE BY REDUCING THE SIZE OF YOUR CHIMNEY



Thermix Fan-Stacks are comparatively lightweight and can be installed at a level with the top of boiler, saving material from the ground to that point as well as at the top, and reducing the breeching to a minimum.

They produce a better controlled draft than an ordinary stack or chimney four to five times as high. Being tapered, they are of smaller average diameter than cylindrical steel stacks, and need only one support for the fan and stack. Consequently, they cost less for material and less for labor.

Another thing, Thermix Fan-Stacks save much steel, which is vitally important to the war effort.



Hundreds of power plants for central power stations, war plants for the Army and Navy and manufacturing plants of all types have been equipped with Thermix Fan-Stacks during the past 20 years.

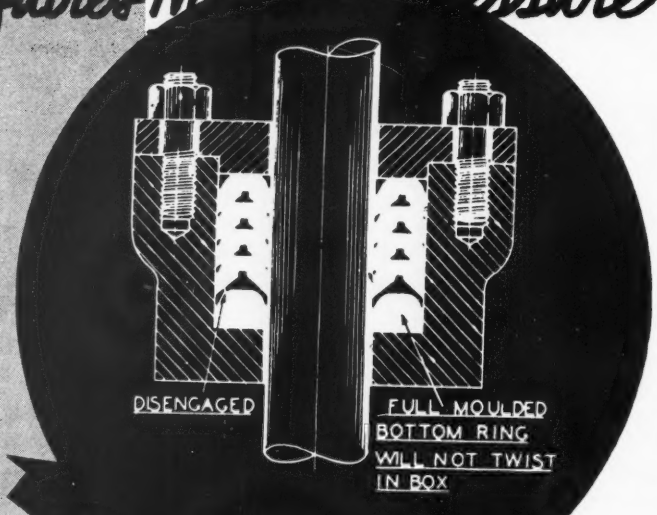
Other advantages are explained in our Catalog No. 109. Write for a copy.

PRAT-DANIEL CORPORATION
E. Port Chester, Conn.
Thermix Engineering Co., Greenwich, Conn.
Project and Sales Engineers
Representatives in Principal Cities

THERMIX FAN STACK

This TRULY AUTOMATIC Packing

requires NO ... pressure



Why

THESE BOTTOM RINGS ARE "TOPS"

Straight sides of Parachute Bottom Rings are identical in shape to the sealing rings and will guide it to original position without twisting in the box. Moreover, these full molded bottom rings can be beveled to conform to any stuffing box angle.

...rity of Chesterton ...ccumulators and ...t it requires no gland pressure, and is therefore a truly automatic packing.

Before a set of Parachute Packings goes on the job, we take into account: (a) the depth of the stuffing box; (b) distance gland enters the box; (c) the fluid pressure —in order to provide for predetermined expansion; save you the bother and expense of after-adjustments.

Chesterton Parachute Packings are sold in all principal cities by Factory-Trained Distributors. Write for Catalog 22-E which describes complete Chesterton line; includes helpful Packing-Selector Chart.

A. W. CHESTERTON CO.

64 INDIA STREET • BOSTON, MASS.

Factories: Melrose, Mass. • Chicago, Ill.

CHESTERTON

Parachute Packing

FOR HYDRAULIC EQUIPMENT

Waste Pipes Clogged Up?

"MILLER'S" Cleanout Tools are used all over the country by leading engineers for clogged up Drains, Gas Lines, Chemical Lines, Sewers and Toilets. This Miller unit is one of the most efficient ever produced. The high speed gear handle whirls a strong flexible rod through bends, angles, traps and elbows—driving through stoppages in a jiffy. It will use a ¼-inch, ⅜-inch, or ½-inch rod and accommodate as much as 30 feet. Guaranteed to do the job.

Send For Our New Catalog Today

J. C. MILLER TOOL SALES

5914 Wilson Ave. Chicago 30, Ill.

and for a long time during this period the Central Pennsylvania territory also has been covered from Philadelphia. In later years, however, the Central Pennsylvania territory was covered from the home office in Allentown.

In order to give more efficient service to the customers located along the Eastern Seaboard, the company has recently merged the Philadelphia and the Central Pennsylvania sales territory into one territory to be known as the Middle Atlantic District with headquarters in Philadelphia.

Effective immediately the company will be represented in the Middle Atlantic District by the Automatic Coal Burner Company, 3614 Walnut Street, Philadelphia, Pa. The territory to be covered will include all of Southern New Jersey, south of and including Trenton, all of the counties in Central and Southeastern Pennsylvania, as well as the entire state of Delaware, with no territory in Maryland whatsoever.

A new office also has just been opened in Albany, New York, where the McClave Co. is represented by Furnaceman, Inc., 238 Washington Avenue. This office will represent the McClave interests in the Albany Sales District territory.

NEW ENGINEERING BOOKS

Symposium on the Identification of Water-Formed Deposits, Scales, and Corrosion Products by Physico-Chemical Methods; 44 pages; 6 by 9 in.; paper cover; copyright 1943; American Society for Testing Materials, 360 S. Broad St., Philadelphia 2, Pa.; price 65 cents each.

This booklet, an authorized reprint of part of the 1943 Proceedings of the ASTM, includes three technical papers, general discussion, and an extensive introduction describing the use of physico-chemical methods in identifying water-formed deposit scales and corrosion products. To provide the information a series of tests were carried out in cooperating laboratories involving macrochemical analysis, petrographic examination, and X-ray diffraction. Details of this test and the interesting results are described in the introduction by H. C. Miller. The technical papers by outstanding authorities cover: X-ray Diffraction Methods in the Study of Power Plant Deposits —C. E. Imhoff and L. A. Burkardt; Diagnosis of Water Problems at Limbo Station—Everett P. Partridge, R. K. Scott, and P. H. Morrison; The Interpretation of Analyses and Problems Encountered in Water Deposits —J. A. Holmes and A. O. Walker.

Graphical Solutions. By Charles O. Mackey; second edition; copyright 1944; 5½ by 8½ in.; 152 pages; hard cloth binding; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $2.50.

Being the outgrowth of a course offered at Cornell University to juniors and seniors, this interesting book assumes on the part of the reader a thorough knowledge of logarithms, algebra and plane geometry, and some

SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

Generate the Electric Power at

BROWN & BIGELOW

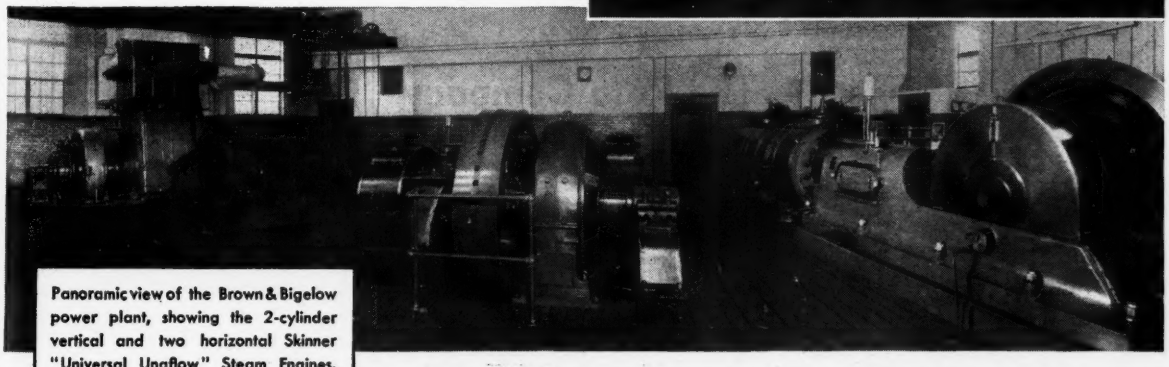
"Remembrance Advertising"
REG. U. S. PAT. OFF.

SAINT PAUL, MINNESOTA

HOUSED in this stately building, with its classic Greek columns and attractive facade, are the giant printing presses and various kinds of machinery which produce the beautiful art calendars and the "thousand and one" clever, useful items of Remembrance Advertising, that have earned for Brown & Bigelow the reputation as "The House of Quality" in the advertising specialties field.

To produce this merchandise economically requires an abundant supply of unfailing and low cost power. Since 1922 this company has been generating its electric power with Skinner "Universal Unaflow" Steam Engines—utilizing the exhaust steam for heating and processing purposes. By so doing, the farsighted, efficient management has saved, and will continue to save, many thousands of dollars in power costs.

Like Brown & Bigelow, more than 2,000 power users in industries and institutions of various types are making savings by producing electric power with Skinner "Universal Unaflow" Steam Engines. Case studies pertaining to your particular industry will be sent upon request. Our research and engineering departments are available now to discuss your power costs for the future.



Panoramic view of the Brown & Bigelow power plant, showing the 2-cylinder vertical and two horizontal Skinner "Universal Unaflow" Steam Engines.

Do More Than Before—Buy EXTRA War Bonds

ARMY E NAVY

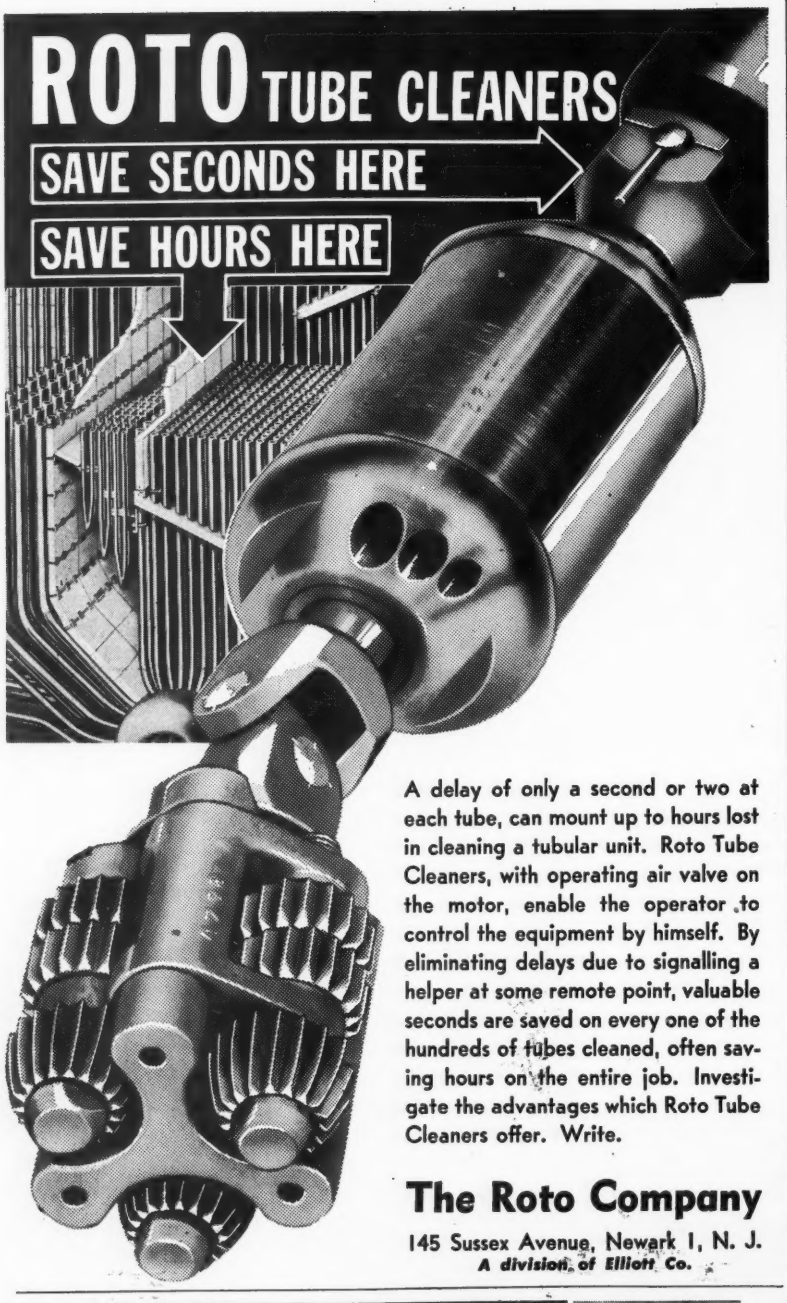
For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

ROTO TUBE CLEANERS

SAVE SECONDS HERE

SAVE HOURS HERE



A delay of only a second or two at each tube, can mount up to hours lost in cleaning a tubular unit. Roto Tube Cleaners, with operating air valve on the motor, enable the operator to control the equipment by himself. By eliminating delays due to signalling a helper at some remote point, valuable seconds are saved on every one of the hundreds of tubes cleaned, often saving hours on the entire job. Investigate the advantages which Roto Tube Cleaners offer. Write.

The Roto Company

145 Sussex Avenue, Newark 1, N. J.

A division of Elliott Co.

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

problems require an understanding of calculus. In this second edition the discussion of the construction alignment charts has been expanded, the use of determinants are given greater consideration, projective transformation is discussed and new illustrative examples and exercises are included. The subjects of the six chapters are: Stationary Adjacent Scales, Sliding Scales, Network or Intersection Charts, Alignment Charts, Empirical Equations—Non-Periodic Curves, and Empirical Equations—Periodic Curves.

Graphical Solutions is a mathematical textbook, and as such leads the reader step by step along fundamental paths to an understanding of the construction of graphic calculating charts. The book is recommended to those who are mathematically inclined and are confronted with a large number of similar specific problems, such as design calculations and calculation of test results, the solutions of which are most easily and satisfactorily carried out by means of graphic charts.

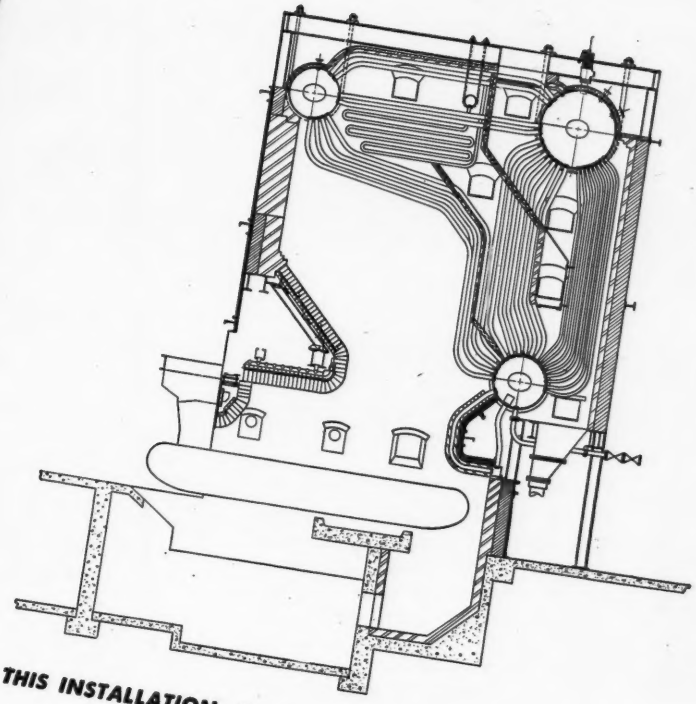
Source Data on Municipal Water Treatment Plants in the United States. By M. C. Schwartz. Published by Louisiana State University Press, Baton Rouge, La., as Engineering Experiment Station Bulletin Series No. 5; 6 by 9 in.; 52 pages; paper bound. Price 50 cents.

In the introduction the author calls attention to the large number of public waterworks and the evolution of the art and science of water treatment. He lists here the available literature, pertaining specifically to the subject, under such headings as: Analyses of Supplies, Temperature, Sources of Supplies, and Statistical Summaries on Water Treatment Plants. Part II is an index to literature describing municipal water treatment plants in the United States, arranged alphabetically according to the cities in which the plants are located, and Part III is an index of municipalities by states.

Practical Design of Welded Steel Structures. By H. M. Priest. Copyright 1943; 5 by 8 in.; 150 pages; cloth cover; published by the American Welding Society, 33 W. 39th St., New York 18, N. Y.; price $1.00.

In this book are set forth the essentials of welding and welded construction with emphasis on that information that will be of use to the man who does design work. The common welding processes are briefly described, these being designated as metal arc, oxyacetylene, carbon arc, resistance and submerged metal welding. Brief but adequate descriptions are given of fabricating tools, specifications for electrodes, types of welds, welding positions, qualification tests and inspection. Because of its importance, weld geometry and stress concentration are treated at some length. Extended attention is also given to temperature effects. Codes of the American Welding Society are given an entire section. Typical structural members are given general and detail design consideration, beam connections are fully treated and considered in the light of continuous structures. Numerous charts, to facilitate the design of welded joints and structural members, are so arranged as to be applicable for any specified unit working stresses. The book should prove helpful in giving a good working knowledge of some of the fundamentals that underlie sound welding design.

EDGE MOOR WATER TUBE BOILERS



THIS INSTALLATION: 3-drum, with superheater, coal-fired.

CAPACITY . . . . . 43,000 lbs. steam per hour.
DRUM PRESSURE . . . . . 275 lbs.
DEGREES OF SUPERHEAT 240
FINAL STEAM TEMPERATURE . . . 650° F.

This steam generating unit is normally fired with roundup screenings. Lignite fuel has been successfully used.

- Edge Moor Boilers are designed for any required capacity and up to 900 lbs. drum pressure. Complete steam generating units are available, including boilers, superheaters, water walls, economizers and air preheaters.

STEAM GENERATING EQUIPMENT

EDGE MOOR

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
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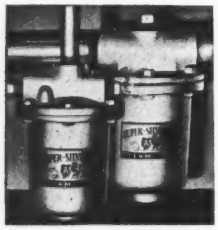
MAIN OFFICE: EDGE MOOR, DELAWARE

Plans specifying SUPER-SILVERTOPS *provide future* STEAM TRAP *economy*



Suppose plans call for 25 to 100 steam traps. What trap will you specify? One requiring the purchase of many fittings and several hours installation time . . . that will have to be taken off the line for inspection or change of parts. Or, a Super-Silvertop Steam Trap that requires only one fitting . . . that saves an hour's installation time and can be inspected without removal. Multiply these savings, both now and over the years, by the number of traps you will need and you'll find it's more economical to install Super-Silvertops in the beginning. Send for the book, "How to Choose a Steam Trap", before you specify any trap.

THE V. D. ANDERSON CO. . 1939 W. 96th St., Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS

Cuts your gasket costs in half

The most remarkable tool ever invented

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THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere ***Mamaroneck, N. Y.***

XZIT
Cleans from fire-box to top of stack

Removes fire-scale and soot while boilers operate

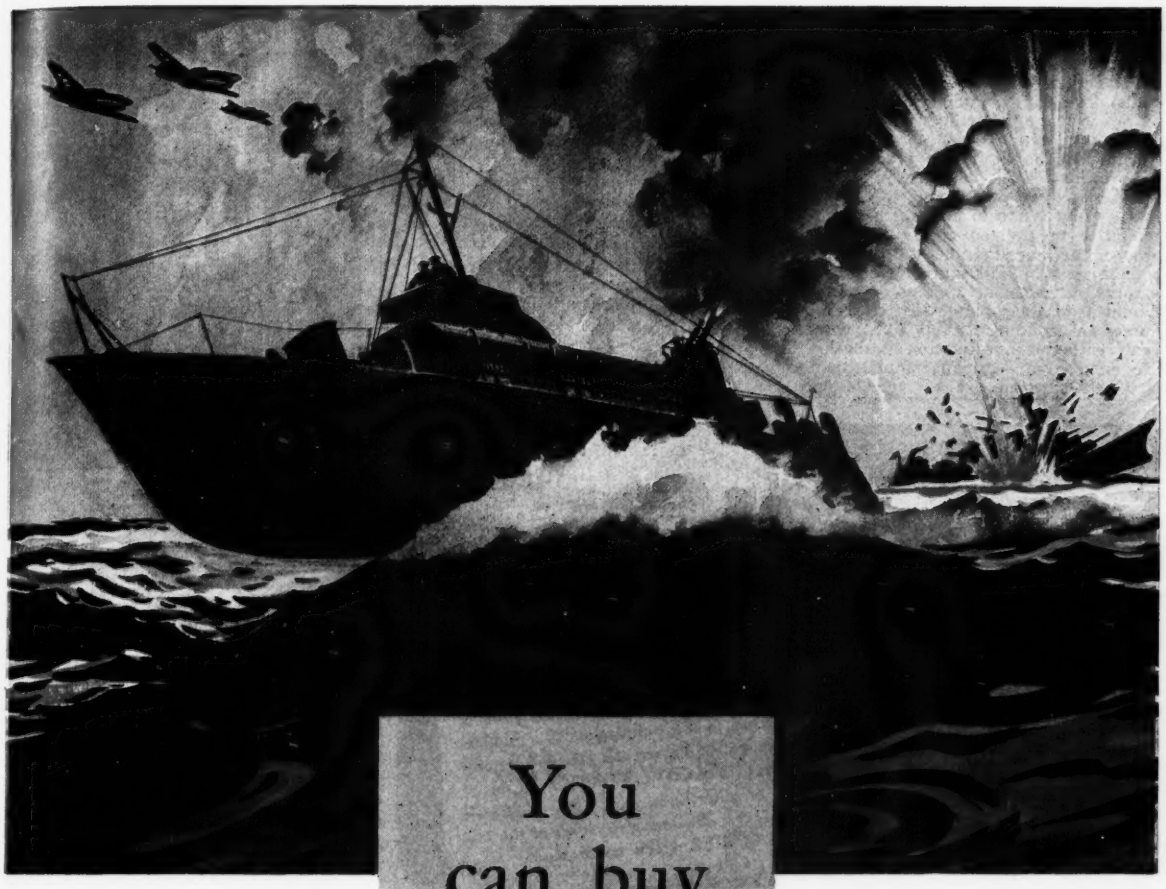
Why tolerate fire-scale, soot, sparking and stack fires, when these are so easily and quickly eliminated with Xzit?

Fed into the fire-box while the boiler remains in operation, Xzit chemically removes soot and loosens fire-scale so it drops off.

By keeping heating surfaces clean from fire-box to top of stack, Xzit gives you increased fuel efficiency, reduces blowings, and keeps equipment on the line longer. Xzit eliminates sparking and puts out stack fires instantly.

Our service engineer will gladly demonstrate Xzit in your plant. Write.

XZIT SALES CO.
1031 Clinton St., Hoboken, N. J.



You can buy Engines proved in Hell

NEW POWER FOR A NEW WORLD

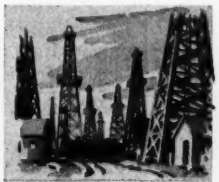
Sterling engines are now being tested for their post-war assignments on the toughest proving grounds of all times—the fighting fronts of the world. They are powering the battle craft of the Allied navies and armies.

The war has taught us to build Sterling engines that better meet the needs of a wide range of applications in the industrial as well as the marine fields. Now these engines give greater horsepower per pound of weight and give more economical operation than ever before. And still they are precision-built.

Write us and we shall be glad to put at your disposal immediately the technical ability of Sterling engineers and the invaluable experience of practical field men to help you replace immediately your overworked stationary and stand-by engines.

STERLING ENGINE COMPANY, Buffalo, N. Y.
Offices in New York, Washington, Chicago.

Coal for America comes from mines ventilated by fans operated by Sterling driven generator units.



"Black Gold" is lifted 15,000 feet or more from out of the ground with pumps powered by Sterling engines.

Mountain streams forced by Sterling driven pumps turn deserts into fertile and profitable productive farm lands.

When disaster strikes, Sterling engines are immediately on the job to supply stand-by power in any emergency.

For civilian purposes of a hundred sorts Sterling can provide engines greatly improved over former pre-war design.

STERLING ENGINES

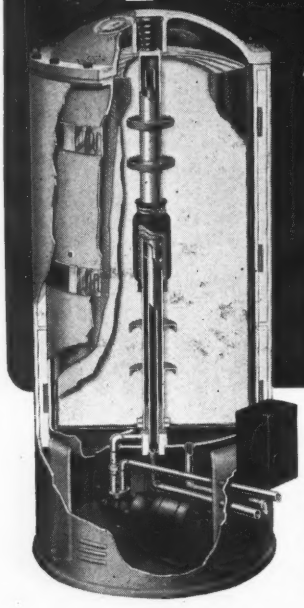
GASOLINE DIESEL GAS

"KEEP BUYING WAR BONDS"

The Hydrogenation of Coal at High Temperatures. By J. L. Bray and R. E. Howard. Issued by Purdue University, Lafayette, Ind., Engineering Experiment Station as Research Series No. 90, dated September 1943 and priced at 25 cents. The data contained in this 6 by 9 in., 55 page bulletin were secured through research work sponsored at Purdue University by the Indiana Gas Association. This bulletin is the first of a series of reports having to do with the hydrogenation of coal, with special reference to Indiana coals. The purpose of the investigations is to develop something that will take the place of natural gas when its sources of supply diminish to the point where it is no longer an economical fuel. This report deals with the investigation of the hydrogenation of Indiana fourth-seam coal without the use of vehicles or catalysts in the temperature range from 750 F to 1060 F and at pressures up to 4500 psi. The investigation indicates that the presence of hydrogen modifies the ordinary destructive distillation of coal tremendously, and evidence is given to show that the volatile matter distilled from the coal is ultimately reduced to methane by a combination of cracking and hydrogenation.

Flow of Water Through Small Swing-Check Valves. By F. W. Greve. Issued as Research Series No. 88 by Purdue University, Lafayette, Ind., Engineering Experiment Station, dated May 1943 and priced at 15 cents. This 6 by 9 in., 20 page bulletin describes in detail tests made on ½, ¾, 1, 1½ and 2 in. swing-check valves to determine the loss of head involved in the flow of fluids through valves of this type.

The Proven Engineering Features of
HONAN-CRANE
"Continuous" Oil Purifiers



☆ The Advanced Engineering and Design of Honan-Crane "Continuous" Oil Purifiers is the result of more than 20 years of experience in the building of Oil Purification Equipment. Proven and patented features guarantee EFFECTIVE PURIFICATION of Diesel or other Lubricating Oils. Illustrated below is the detailed breakdown of the important CENTER TUBE construction.

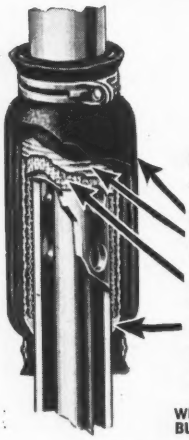
CENTER TUBE CONSTRUCTION

CLEAN OIL OUTLET is located at the top of the Purifier which provides maximum efficiency from the refill and a false oil level in the reservoir is avoided by preventing the oil from draining back. This will happen when the outlet is at the bottom or middle of refill and the Purifier is located above the oil reservoir.

Baffle plates guide oil flow.

Clean oil must pass through felt and metal screens to reach clean oil chamber.

All oil lines are thoroughly sealed and gasketed to prevent dirty oil seepage into the clean oil line.



CENTER TUBE INLET

The center tube inlet is carefully guarded by:

Replaceable dense highest grade wool felt.

Heavy fine mesh metal screen brazed to center tube.

Coarse metal spacer cloth brazed to center tube under screen.

Screens brazed to center tube.

This triple protection insures against any possibility of either the purifying medium or dirt from the oil getting into the clean oil stream.

WRITE FOR COMPLETE SPECIFICATIONS AND ENGINEERING BULLETINS ON PURIFICATION OF LUBE AND FUEL OILS

HONAN-CRANE CORPORATION
301 WABASH AVENUE, LEBANON, INDIANA
Subsidiary of Houdaille-Hershey Corporation

Your Blueprint for
MORE POWER
starts with
OAKITE CLEANING

. . . Cleaning Air Filters, Diesel Filters, Other Types

Removing dirt, pollen, lint, oil and other impinged deposits from air filters presents a recurring cleaning problem which specialized Oakite materials are particularly designed to remove.

These dependable materials do the work easily, quickly, economically. They speedily restore washable units to full filtering capacity, and are equally effective in cleaning filters for air conditioning systems, for Diesels and for other operating equipment . . . whether the filtering medium is spun glass, metal shavings or crimped wire.

10-PAGE MANUAL GIVES DETAILS

This helpful guide also describes how to safely descale Diesel cooling systems, clean lube oil coolers, strip paint from transformers, and do over 60 other maintenance jobs. Write for your FREE copy.

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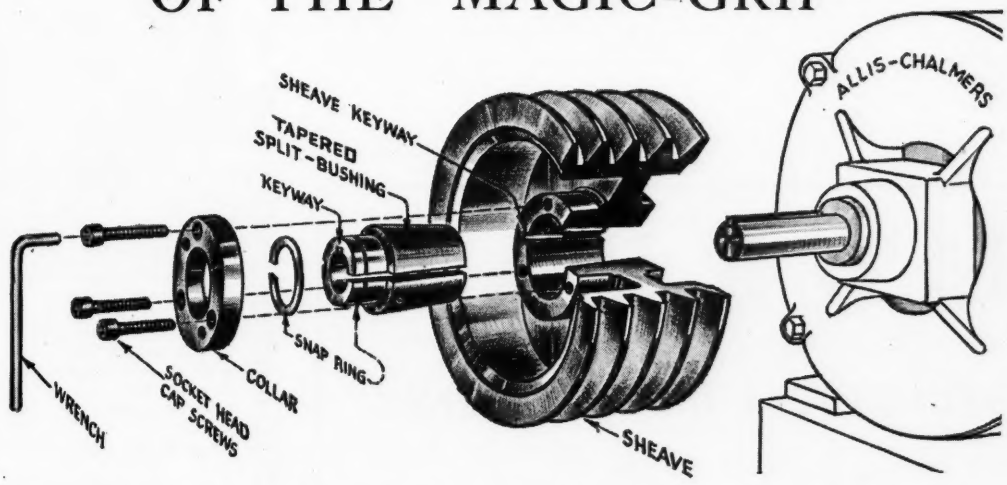
23 Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

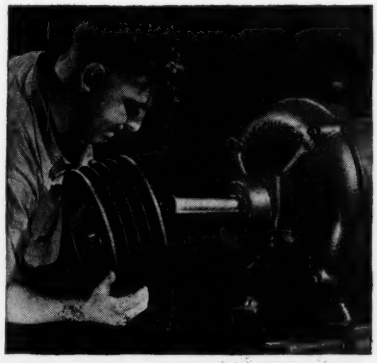
OAKITE *Specialized cleaning*
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Here's the Secret

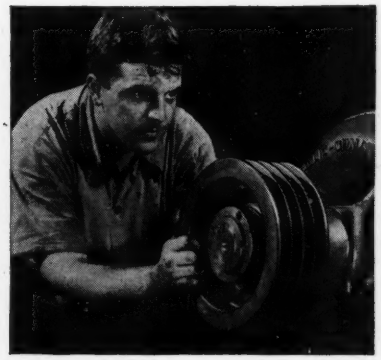
OF THE "MAGIC-GRIP"



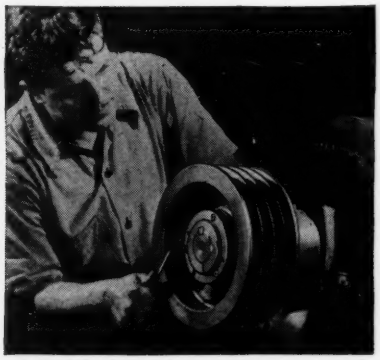
Exploded view shows why Allis-Chalmers' new "Magic-Grip" Sheave goes on *as a unit in 3 easy steps.* It's the fastest mounting sheave on the market—at no extra cost.



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.



3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1764

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

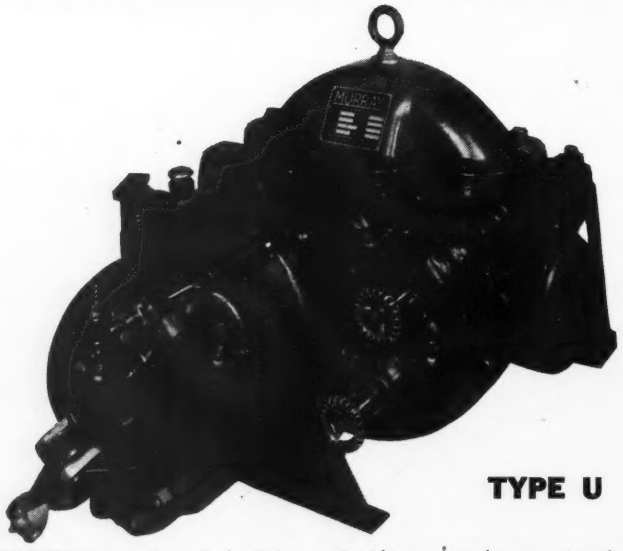
Among the conclusions are that the loss stayed almost constant for all valves when the velocity of flow was 1.0 fps or less, increasing only 0.012 ft from 0.225 ft (± 0.003) at a velocity of 0.50 fps to 0.237 ft (± 0.028) at a velocity of 1.0 fps; and that a minimal velocity of flow of between 5 and 6 fps in the pipe is required to maintain the check of an accompanying valve in wide open position.

Electrical Technology and the Public Interest. By Frank J. Kottke; Published by the American Council on Public Affairs, 2153 Florida Ave., Washington, D. C.; 1944; 6 by 9 in.; 200 pages; price, cloth bound $3.00, paper bound $2.50.

Through this study of the interrelationship of technological change and the organization of industries engaged in the manufacture of patented products, the author has presented many facts regarding the practical operations of the present patent system in the United States. "What is chiefly attempted here," the author states in his preface, "is an analysis of those instances where there has been some relation between certain industries and

MURRAY

SINGLE STAGE MECHANICAL DRIVE TURBINES



TYPE U

BUILT in a variety of wheel sizes, with either two or three-row impulse type bladed wheels, with all materials suitable for the specified steam conditions. May be obtained with any type of governor, for either constant or variable speed operation.

Type "U" Turbines are designed to have the ruggedness expected of single stage turbines. Their simplicity of construction results in utmost ease of disassembly.

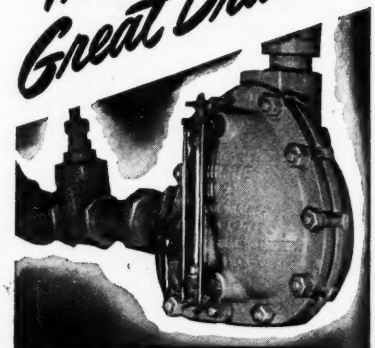
Ask for Descriptive Bulletin T-118, or assistance from District Offices in all principal cities.

Other Murray Products:

Direct Connected and Geared Multi-stage Turbines, Type "UV"
Vertical Turbines, Reduction Gears, High Speed Type
Turbine Generators up to 2500 KW rating

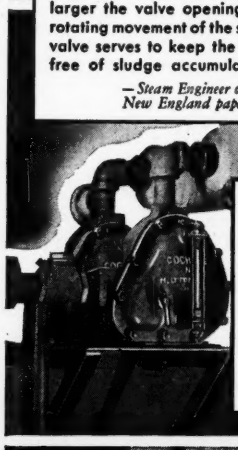
MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

Tribute to a Great Drainer

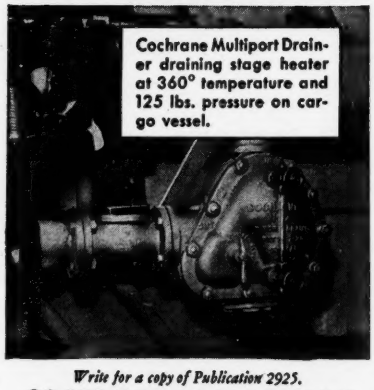


"These traps" (Cochrane Multiport Drainers) "discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

—Steam Engineer of large New England paper mill.



Two Cochrane Multiport Drainers handle condensate returns for process, in a large southern printing plant.



Cochrane Multiport Drainer draining stage heater at 360° temperature and 125 lbs. pressure on cargo vessel.

Write for a copy of Publication 2925.

COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia 32, Pa.

COCHRANE
DRAINERS

Prevent Explosions

WITH fireye PHOTOELECTRIC FLAME SAFEGUARD IN OIL, OR PULVERIZED COAL BURNERS

WHAT FIREYE DOES ... HOW IT DOES IT

The photoelectric cell of Fireye observes pilot, main flame or both through a small window in the wall of the fire chamber.

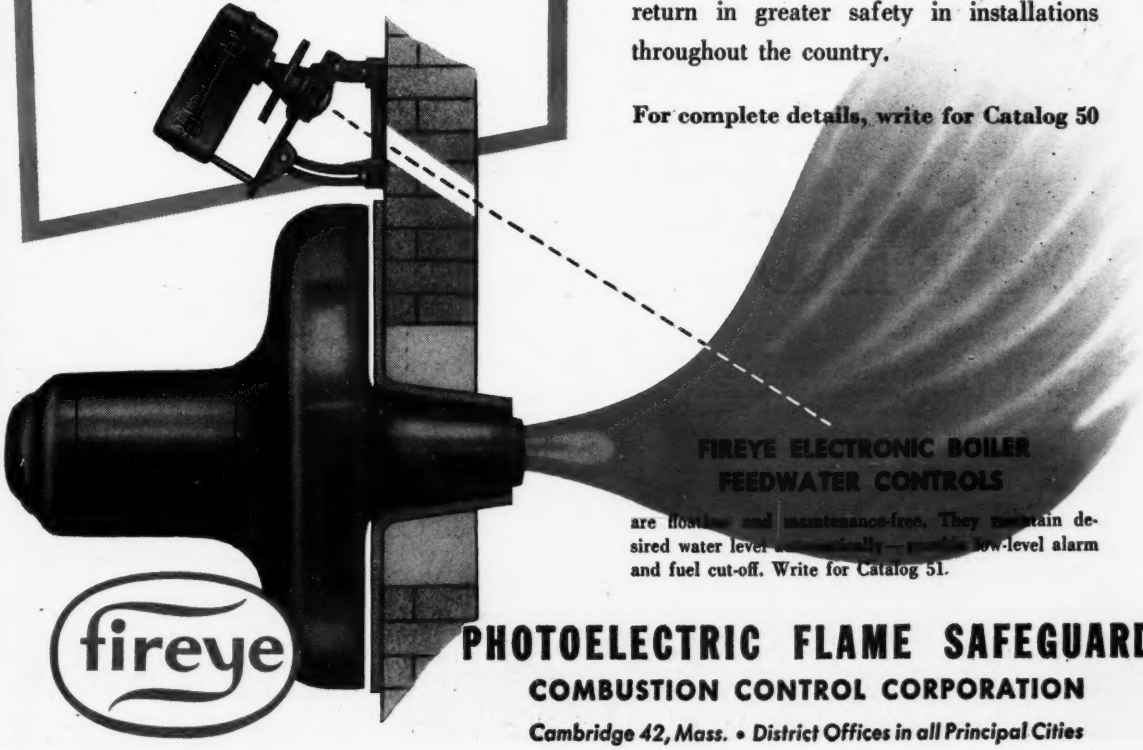
When the flame fails Fireye acts *instantly*, releasing a flow of electrons—a microcurrent that is amplified to control manually ignited burners by turning off both main and pilot fuel valves and sounding an alarm . . . or when burner is fired automatically, to provide desired sequence of fuel pump and valve operation.

The danger of explosion is ever present in pressure-fed heating equipment. Fireye Photoelectric Flame Safeguard acts to prevent this hazard—acts with the speed of light, the light of the flame itself.

Thus—there is no *danger interval* between flame failure and fuel shut-off . . . no time for the oil or pulverized coal to enter the combustion chamber and create a dangerous explosive mixture.

Fireye equipment is a self-contained unit of proved performance, easily installed—a moderate investment that is paying a high return in greater safety in installations throughout the country.

For complete details, write for Catalog 50



FIREYE ELECTRONIC BOILER FEEDWATER CONTROLS

are float-less and maintenance-free. They maintain desired water level automatically—provide low-level alarm and fuel cut-off. Write for Catalog 51.

fireye

PHOTOELECTRIC FLAME SAFEGUARD

COMBUSTION CONTROL CORPORATION

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their technological improvements." He warns that "if control over the most effective technological methods were to become concentrated in a few corporations the result might be as serious as similar monopolization of the sources of raw materials or long-term capital funds."

The book is factual throughout representing the findings of the author through numerous interviews with officials of representative manufacturing companies supplemented by corporation reports, government documents, articles in professional journals and other available sources of information. Chapter headings include: The Problem and Its Significance, The Nature and Objectives of Industrial Research, The Patent Privilege as a Stimulus to Industrial Research, Improved Techniques of Leading Firms, Improved Techniques of Smaller Firms, Technical Progress and Industrial Integration, Innovation as a Basis for Restriction of Entry and Division of the Field, Patent Licensing Practices and the Modification of Competition, The Relationship of the Consumer, and Toward a New National Policy.

Throughout the book references are made to published literature on the subjects treated and an extensive bibliography refers the reader to books, periodical articles, government publications and court documents. Those investigating the United States patent system will find this book helpful in pointing to ways in which the system is used by industry.

"WE READ WATER"

These are photographs of our new analytical and control laboratories where "we read water." Scores of water samples received daily are given careful and complete analyses under the most modern methods of determinations by graduate chemists. Our application of Chrom Glucosates to scale and corrosion control in cooling systems, boiler and water systems has brought such a response that it has necessitated these larger analytical laboratory facilities. Take advantage of these completely equipped laboratories and our highly trained staff to find the answer to your problems in scale, corrosion and algae.

Write today for our booklets, or let a Haering Field Engineer call and study your problems without obligation.

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2. East bank of laboratory wells at analytical and control laboratory.
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4. Balance and Microscope Room.
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ENGINE *ALARM* SYSTEMS

TYPE M
CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

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Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

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Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

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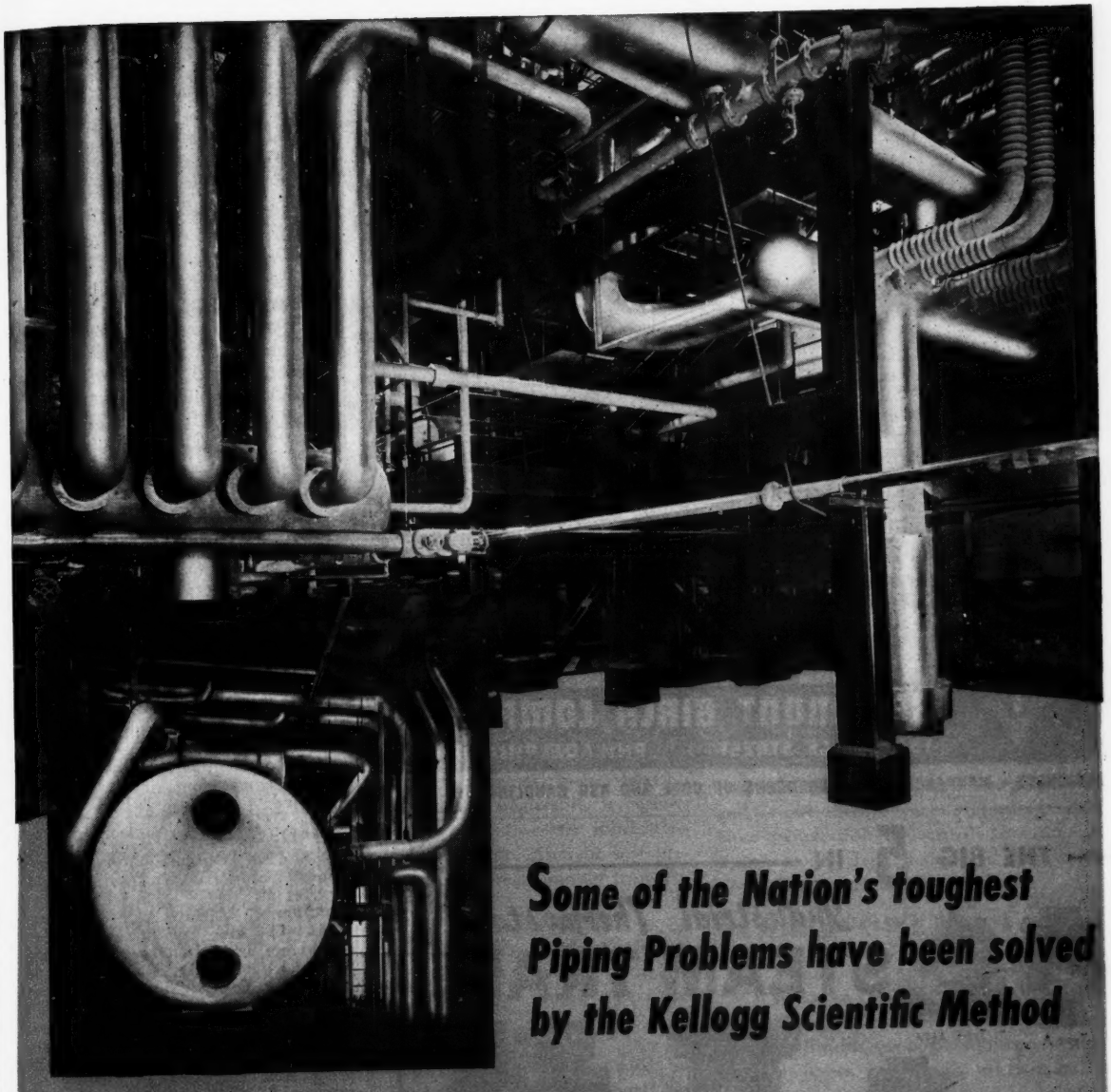

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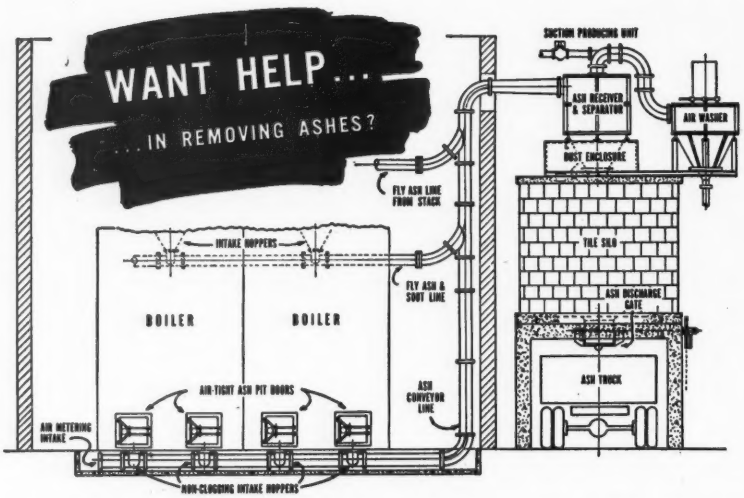

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NO AIR-BINDING—Discharge air as efficiently as water.

NO FREEZE-UPS—Designed to drain when cold.

NO ADJUSTMENT, for any pressure.

NO DRIBBLING — Intermittent action; wide open when cold.

NO WATER-LOGGING—A few degrees difference between steam and condensate opens valve.

★ *Five types.*

★ *Sizes ¼" to 2".*

★ *2 to 6 times greater valve area.*

★ *Pressures to 225 lbs.*

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A large internationally known Machinery Manufacturer requires the services of Mechanical Draftsmen in Engineering Division. These men must be conversant with Air Conditioning and Refrigeration equipment, Metal Construction, Electrical Control Wiring. Positions offer permanency with opportunity afforded by an expanding operation. Write stating qualifications, age, nationality. All replies will be held strictly confidential. Address Box 1444, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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An opening is available now with the West's largest manufacturer of power equipment, for a steam turbine sales engineer and for a turbine application engineer. If you are well qualified for these positions and want to line up your post-war plans for a successful up-and-coming future, contact:

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General Sales Department
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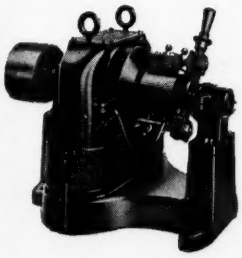
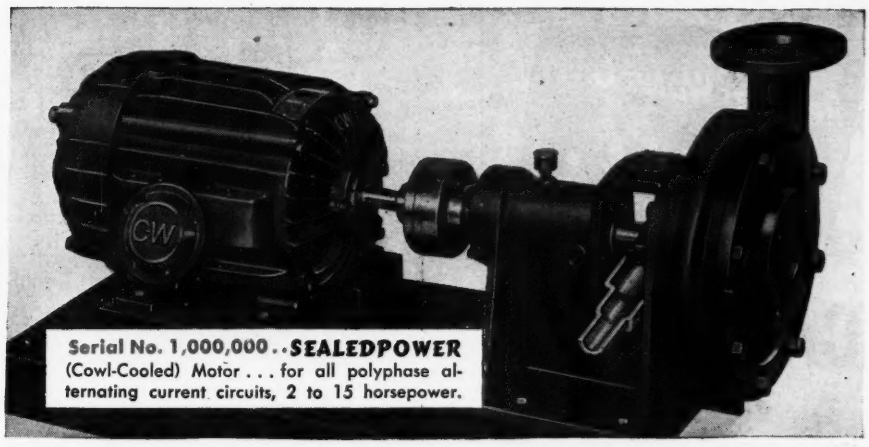
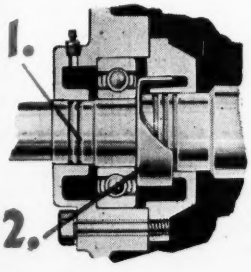


Serial No. 1 . . . Crocker-Wheeler Motor, built in 1888.



Serial No. 1,000,000 . . SEALEDPOWER (Cowl-Cooled) Motor . . . for all polyphase alternating current circuits, 2 to 15 horsepower.



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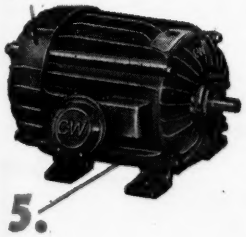

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SEALEDPOWER

Industry's Most Trouble-Free Motor

PRODUCED BY CROCKER-WHEELER'S 56 YEARS OF EXPERIENCE

CROCKER-WHEELER FEATURES:

1. Patented "Groovseal"—no greasing needed for at least a year. Grooves minimize grease loss. This seal makes bearing maintenance expense negligible. It permits use of softer grease, for better lubrication and longer bearing life. Airtight seal prevents dust or other foreign matter from entering bearings.

2. Crocker-Wheeler's exclusive De-Sludging Impeller. Automatically desludges . . . churns and distributes grease to bearings when motor is started.

3. Vacuum Impregnation—standard on *all* Crocker-Wheeler motors. Seals out foreign matter and moisture from each individual coil . . . fills all interstices, making windings a homogeneous mass . . . reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires either inside or outside of slot. (Photograph shows cross sections of baseballs, (left) after vacuum impregnation and (right) before vacuum impregnation. Note penetration of varnish to center of tightly-wound ball, making it a moisture-proof, homogeneous mass.)

SEALEDPOWER FEATURES:

4. Totally Enclosed Cowl-Cooled Construction resists corrosion. Protects against acid or alkali fumes, splashing or dripping liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, etc.

5. Fin Type Construction for non-clog ventilation and easy cleaning.

WRITE FOR LITERATURE ON THE **SEALEDPOWER** MOTOR, WHICH IS WINNING THE PREFERENCE OF MACHINERY MANUFACTURERS AS WELL AS OF MOTOR USERS. OR CALL OUR NEAREST OFFICE.

CROCKER-WHEELER Motors-Generators

JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

ESTABLISHED 1856

AMPERE, NEW JERSEY

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SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS

Restores Water Level *fast..*

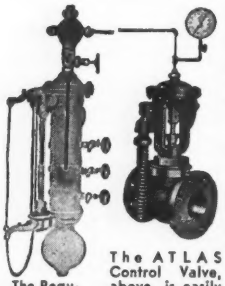
CAMPBELL

FEED WATER

REGULATOR

The CAMPBELL Regulator slows down the feed when a sudden increase in load develops and gives the boiler a chance to overtake the load before the regulator again feeds at a rate to balance output.

When a sudden decrease in demand causes the water level to drop, the CAMPBELL speeds up the input—quickly restores the water level.



The Regulator and Sampling Pipe

The ATLAS Control Valve, above, is easily piped to the Regulator

Simplified, trouble-free construction is another feature of the CAMPBELL that engineers approve. It is easily attached to any water column and eliminates the need for expert servicing. It soon repays its cost through dryer steam and smoother boiler operation.

Besides the CAMPBELL offers: Continuous Blowdown; No Moving Parts; No Thermostats; No Floats; No Links; No Generators; Lifelong Dependability, and Maximum Economy. Write for further details about this and other ATLAS Products.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

291 South St., Newark, N. J.
Representatives in Principal Cities

☐ Please send complete information on the CAMPBELL Boiler Feed Water Regulator. Also please send information on the following Atlas products—

☐ Damper Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control Systems
☐ Pressure Regulators
☐ Pump Governors
☐ Float Valves
☐ Oil Control Cocks
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
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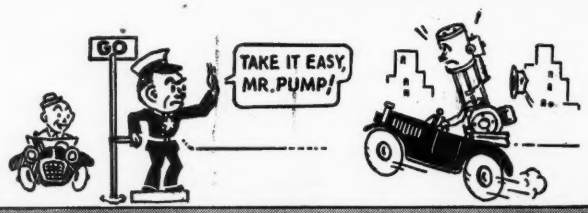


COMBINATION

NON-TILT, NON-SLIP VALVES

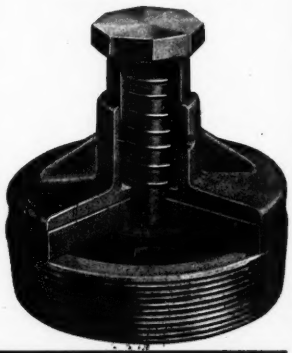
Protect Pumps against wasteful "over-speeding"

The tilting action of some reciprocating pump valves causes the seat to wear unevenly—which means the pump has to work faster and faster to carry its load.

COMBINATION Pump Valves enable you to get theoretical capacity out of your pumps without racing and wasting valuable steam. They prevent tilting and consequent pump slippage because they lift straight. They save on repair bills, too, because their seat, stud and springs are made of long-wearing Phosphor Bronze.

These improved pump valves match the fine performance of COMBINATION Silent Check Valves. Ask for descriptive folder with dimensions, prices and further information.

For Boiler Feed
Vacuum, Condenser
General Service



COMBINATION PUMP VALVE CO.
846 Wiota Street, Philadelphia, Pa.

IMO

Serves STEAM OR DIESEL

IMO
I MOVE OIL

This De Laval-IMO fuel-oil transfer pump is installed on a Diesel-driven C-2 cargo vessel. On steamships De Laval-IMO pumps supply oil at high pressure to burners. De Laval-IMO pumps circulate "lube" oil on both motorships and steamships. IMO pumps handle any quantity of any oil against any pressure. They have only three moving parts, no valves, no gears and no cams, are free from vibration and pulsation and can be coupled directly to standard speed motors or turbines.

Ask for Publication I-110

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

CHIMNEYS
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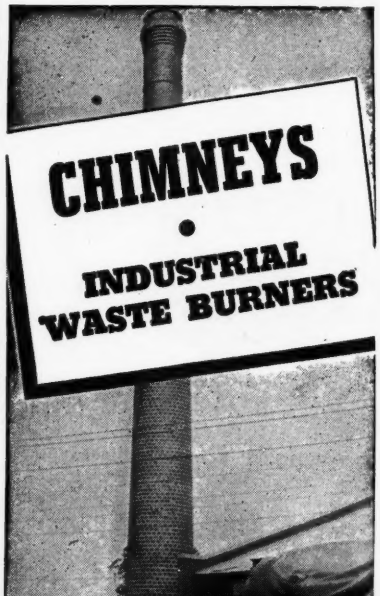
INDUSTRIAL WASTE BURNERS



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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **Radiant Type Boiler**—Bulletin RB describes a patented 4-drum boiler design that is said to double the usual radiant exposure found in 4-drum boilers. This feature provides faster steaming capacity, lower furnace temperatures and maintenance, lower setting costs. Union Iron Works.

2 **Ash-Handling Equipment**—Catalog describes different ash disposal systems and also gives factors that determine which type to use. It lists such methods as disposal directly into trucks, or sluice systems, to fill vacant land or carry the ashes to a suitable pit. Hydro-Ash Corp.

3 **Belt Conveyor Data Book**—Engineering Data Book No. 105 describes Continental belt conveyors; contains tables and suggestions that will help engineers select conveyors of proper size, speed and power for coal, stone and various materials. Continental Gin Co.

4 **Single-Gas-Pass Boiler**—28-pg Bulletin No. B-44-5 on S-A boiler consists of an assemblage of drawings and photographs, together with operating data of a number of well known plants. Method of operation and photographs showing construction are included. Chart gives heat content of steam. Foster Wheeler Corp.

5 **Sealing Boiler Settings**—New literature tells how Airproofit provides an easily applied air-tight plastic insulation for brick-set boilers. Contains examples of savings effected by this boiler coating. The Airproofit Co.

6 **Boiler Return System**—Bulletin No. 250 "Cut Steam Costs" describes advantages of Stickle differential drainage and boiler return system in plants using steam for cooking and processing at pressures 75 to 200 lb. Photos and diagrams of typical installations, together with performance figures, are given. Stickle Steam Specialties Co.

7 **Steam Atomizing Oil Burner**—Construction features and performance data on National type SA oil burner are covered in illustrated Bulletin No. 21. By using either steam or compressed air for atomizing this burner handles the lowest and cheapest grades of oil or tar. National Airoil Burner Co.

8 **Spreader Type Stoker**—Tube tuyere grates, water cooled parts, adjustable feed and other features of Firite spreader stokers are described in illustrated bulletin. These stokers burn any kind or size of coal smaller than 2½ in., are said to follow fluctuating loads as spontaneously as oil firing. Hoffman Combustion Engineering Co.

9 **Tube Cleaner Handbook**—Opening with three illustrated pages of modern tube cleaner cutter heads, their dimensions and general uses, new Bulletin Y-18 continues with descriptions of Elliott motors driven by air, steam or water. Cutaway illustrations, in color, picture the interior construction of each motor. Special applications for standard equipment such as the use of tube cleaners in oil refineries, locomotives and industrial plants are described. Also gives useful handbook information on proper care and operation of tube cleaners. Elliott Co.

ELECTRICAL

10 **Watthour Meters**—General Electric Co. 24-pg Bulletin No. GEF-2721A contains information on renewal parts for V-type two-element polyphase watthour meters. Photographs of equipment are included.

11 **Speedy Panelboard Conversion**—New 16-pg Booklet CA-575 describes a speedy method of converting obsolete and inadequate electric light and power panelboards to give greater capacity, safety and efficiency without disturbing the box or conduit. Booklet is illustrated with "before" and "after" illustrations accompanied by brief history of each case. Square D Co.

12 **Pyranol Capacitors**—"Engineering Aspects of Pyranol Capacitors in Large Banks" is the title of new 20-pg Bulletin GEA-4225. Covers basic principles of system kvar requirements, application problems, installation data. General Electric Co.

13 **Unitized Switchgear**—New booklets on Unitized switchgear are said to save 30 per cent of usual time required to order, build and install switchgear. Also contain many pages of factual, easy-to-use switchgear information. Westinghouse Electric & Mfg. Co.

FANS, PUMPS AND COMPRESSORS

14 **Regenerative Turbine Pumps**—Bulletin W-324-B2 pictures and describes operating features of Worthington regenerative turbine pumps for general water service, cooling towers, small boiler feed, condensate service, etc. Includes dimensions, rating tables and other useful data. Worthington Pump and Machinery Corp.

15 **Pumping Hand Book**—New Westco Industrial Pumps Catalog No. 43 gives specifications and performance data on pumps for boiler feed, brine circulation, condensate and many other jobs. Contains units of measurement, heads and pressure equivalents and other handbook information. Joshua Hendy Iron Works, Pomona Pump Div.

16 **Gas Engine Compressors**—Bulletin No. L-690-B1 describes LTC angle two-cycle gas engine compressors for gas or air-lift pumping, gasoline plants, refineries, gas transportation lines, repressuring, refrigeration plants, sewage works, pressure maintenance and for general air supply. Worthington Pump & Machinery Corp.

17 **Rotary Pumps**—Bulletin No. 304 describes Blackmer rotary pumps, 5 to 750 gpm, pressures to 300 psi. Contains illustrations of operating details and typical capacity curves to show how these units cut pumping costs. Blackmer Pump Co.

INSTRUMENTS AND CONTROLS

18 **Temperature Regulators**—Catalog 70 contains eight sections of useful engineering data on reducing valves, temperature regulators, pump governors and sirens. Foster Engineering Co.

19 **Photoelectric Control**—New 4-pg Bulletin 316 describes Photoswitch densitometer series D90, a recently introduced photoelectric control for transparency measurement of liquids, gases, films, filters, plastics and similar materials. Photoswitch, Inc.

20 **Combustion Control Catalog**—To describe its new system of combustion control designed especially for the smaller industrial or municipal power plant, Leeds & Northrup Co. has just issued a new catalog, "L&N Combustion Control, Type P." Shows how the system regulates fuel-feed and draft by a simple electrical balance, varying the settings of valves, dampers or vanes in definite proportion to steam demand. At the same time, furnace pressure is automatically regulated. The application of this system to different types of boilers . . . stoker fired, pulverized coal fired, gas fired, and oil fired . . . is shown in the catalog by schematic illustrations.

21 **Flow Rate Measurement**—Catalog 10-B, entitled "A New Era in Flow Rate Measurement" contains latest information on the F&P Rotameter for accurately measuring the flow rate of liquids and gases. Each basic advantage of the Rotameter is discussed; how it works; how it can be made immune to variations in viscosity and specific gravity. Large, semi-humorous illustrations dramatize each point. A list of fluids successfully handled and some typical applications are included. Fischer & Porter Co.

MECHANICAL TRANSMISSION

22 **New Magic Grip Sheave**—Bulletin B6310 contains six photographs illustrating the easy put on-take off operation of the new Texrope Magic Grip Sheave. It is said to fit oversize or undersize shafts, center perfectly, run smoothly, save man-hours by faster mounting. Allis-Chalmers Mfg. Co.

23 **Flexible Coupling Handbook**—Catalog No. 411 tells how American flexible couplings are built to accommodate misalignment with minimum loss of power. Contains coupling dimension tables, also helpful engineering data on load factors for various types of driven machinery. American Flexible Coupling Co.

24 **Standard and Specialized Belts**—New catalog furnishes complete information on the Gilmer line of standard V-belts, endless or non-endless flat belts, and a complete range of specialized belts for use wherever standard belts are unsuited. L. H. Gilmer Co.

25 **V-Belt Drives**—New 33-pg pamphlet, entitled "Goodyear Engineering Data for V-Belts," contains details on care and installation of V-belt drives. One section is devoted to Goodyear's new steel cable V-belts. Goodyear Tire & Rubber Co.

List Items You Want On Handy Coupon On Following Page

PIPING, VALVES AND FITTINGS

26 **Flexible Metallic Pipes**—Bulletin 71 describes Penflex all-metal pipes for Diesel intake and exhaust lines, oil, water and other connections. Bulletin 90 furnishes complete information on Penflexweld for fuel oil feed, starting air, and manifold drain lines. Corrugated, jointless construction provides flexibility—expands or contracts easily with changes in temperature or pressure pulsation. Pennsylvania Flexible Metallic Tubing Co.

27 **Insulated Pipe Units**—How RicwiL prefabricated insulated pipe units speed construction work and conserve manpower is shown in new illustrated bulletin. Simple mechanical coupler for field installation is described; typical specifications for underground piping are listed. Ric-wiL Co.

28 **Valve Reseating Machines**—Catalog 40 describes construction and operation of valve reseating machines for gate, globe and pump valves. Easily operated, reliable, efficient and durable, these machines save valves from discard many times. The Leavitt Machine Co.

29 **Welding Fittings**—Bulletin WF-41, gives complete and interesting information on welding fittings (ells, tees, flanges, nipples, return bends, etc.) that improve design and reduce cost of piping systems. New fittings of this company not previously available are described. New American Standard for butt welding fittings is also listed. Midwest Piping & Supply Co., Inc.

30 **Steam Trap Data**—Tables, charts, price list, how to figure sizes of these traps, and other interesting data will be found in a recently published Bulletin—T-1737. A table of thermodynamic properties of saturated steam is included, as well as a description illustrated by cutaway views showing how an impulse steam trap works. Installation and operating suggestions are also given. Yarnall-Waring Co.

31 **Wartime Catalog Service on Piping Products**—A series of Catalogs with an individual section for each class of product lists all items obtainable and those not being made under Simplification program of National Bureau of Standards. Saves time for piping maintenance men, specifiers, buyers. Crane Co.

32 **Data on Forged Steel Flanges**—Important flange buying information is given in the new catalog of Ladish forged steel flanges. Contains complete descriptions, prices, specifications and other data helpful to engineers and specification writers. Ladish Drop Forge Co.

33 **Modernized Steam Traps**—Illustrated folder tells about the self cleaning vent, reversible valve and seat and other advantages of K-Master steam traps. Includes dimension table and other useful data. Kaye & MacDonald, Inc.

34 **Data Chart on Welding, Fittings**—Tube Turns, Inc., has published a handy pocket-size dimensional data chart which gives complete quick-layout information on every Tube-Turn welding fitting and flange. Printed in two colors, these 9 in. by 24 in. charts are ideal for spreading out on a drawing board or desk, or they can be folded up like a railroad timetable into a 9 in. by 4 in. folder and slipped into a pocket.

WATER TREATMENT

35 **Zeolite Softener**—Elgin double check zeolite water softener equipment is illustrated and described in a new 4-pg folder No. 605. The design is said to increase softening efficiency and increase capacity, making it possible to use more Zeolite in a given softener without loss. Elgin Softener Corp.

36 **Scientific Water Conditioning**—Bulletin furnishes data on the Bird-Archer line of water testing equipment, conductively apparatus, proportioning pumps and chemical feeds. Folder describes "Tanalginate," an organic colloid of reactive and protective type for treatment of boiler water. Eliminates baked sludge, permits increased boiler water concentrations, reduces blow-down and minimizes foaming and priming tendencies. Bird-Archer Co.

37 **Chemical Feeders**—Bulletin describes Manzel chemical feeders for automatic boiler feedwater treatment. Installed on boiler pumps, they automatically feed a small amount of chemical into the line with each pump stroke. Easily adjustable to fit your exact requirements. Manzel Brothers Co.

38 **New pH Control Handbook**—The LaMotte Chemical Products Co. presents a new, 84-pg edition of well-known handbook, "The A B C of pH Control." Its up-to-the-minute information and general catalog section describing the full line of LaMotte equipment and chemical reagents should prove helpful to those interested in the process industries; analysis of water, sewage, and industrial wastes; boiler feedwater; electroplating, etc.

39 **How We Read Water**—A 48-pg H.O.H. booklet discusses steam and return system corrosion—how to get accurate chemical proportioning—refrigerating brines—how we read water—interesting cases of control of corrosion, making pipes and boilers last for the duration—and many other vital water treatment facts. D. W. Haering & Co., Inc.

MISCELLANEOUS

40 **Non-Clogging Heat Exchangers**—Acme heat exchangers, planned to prevent clogging and fouling, are described in new bulletin. Also tells about production of Acme distillation equipment, drying and evaporating systems, other power and process equipment. Acme Coppersmithing & Machine Co.

41 **Robot Oil Reclaimer**—Bulletin YM-700 covering YM Robot oil reclaimer is now available. Operation of these batch reclaimers is automatic and continuous; capable of restoring all kinds of lubricating, hydraulic, cutting and vacuum pump oils so that the reclaimed oil can be re-used. Operators of Diesel engines will find that a single Robot can take care of all their Diesel engines. Capacities range from 4 gallons per hr to 300. The Youngstown Miller Co.

42 **Repairing Rutted Floors**—Folder tells how Stonhard Concretite answers the problem of rough and rutted factory floors. This quick setting slab—ready in 18 to 24 hr—resists wear, water, oils, acids and above-normal temperatures; is easily applied. Stonhard Co.

43 **New Electric Chain Hoist**—Operating and construction details of the new 500-lb "Handi-Lift" electric chain hoist, recently added to the P&H line, are described in Bulletin H-23. Condensed specifications, clearance data, and typical installation photos are included. The unit features high reserve capacity with a genuine hoist motor, a flexible proof-tested chain, and interchangeable mountings for bolt, hook, or trolley suspension. It operates on 220-440 volts, 3 phase, 60 cycle AC. Harnischfeger Corp.

44 **Handy Machine Gas-Cutting Guide**—A free pocket-sized, slide-type guide that shows proper tip sizes, gas pressures, and other data required for machine gas-cutting steel of various thicknesses is now available. By setting the slide to one of the known factors—such as steel thickness—the gas-cutting machine operator may immediately determine the correct tip size to use, oxygen and acetylene pressures required, estimated gas consumption, width of kerf, and average cutting speed to be expected. The back of the guide lists helpful hints for machine gas-cutting operators, including pointers on setting up, piercing starting holes, making heavy cuts, etc. Air Reduction Co.

45 **Wood-Metal Packings**—New bulletin tells where, when and how to use Rains plastic type stuffing box packing. Pictures many installations; contains field notes on savings effected with different types of equipment, scale of weights and sizes. Rains Wood Metal Packings.

46 **Data on Metal Bellows**—Highlights of the principles, construction and engineering advantages of "Spring-life" bellows are portrayed in a new catalog issued by the Cook Electric Co. Characteristics of the Cook "Spring-life" bellows are shown by photographs and diagrams; also included are an application data chart and suggestions for selecting the proper bellows to meet specific requirements in valve regulators, flexible couplings, temperature controls, etc. Cook products employing the Spring-life bellows are pictured in the catalog, as are other Cook-built bellows products.

47 **Industrial Type Unit Dust Collector**—Features and construction specifications, together with the capacities and dimensions, of the new Pangborn Industrial Type "CK" Unit Dust Collector, are covered by Bulletin No. 910. Of particular importance is the flexibility in arrangement permissible for adaptation to specific plant conditions. In three sizes with capacities to 1000, 2000 and 3000 cfm. Pangborn Corp.

48 **Chemical Proportioning Pumps**—Available in 8 types in over 200 sizes for any applications involving pressures to 22,000 psi and capacities from 0 to 1,800 gph, Hills-McCanna chemical proportioning pumps will feed the proper proportion of treating agent regularly, and without fail. Write for Catalog P-41 for complete details and engineering data. Hills-McCanna Co.

This coupon must be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

JULY, 1944

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

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Announcing the Goetze Gasket Film

"Only A Gasket"

with Commentary by
LOWELL THOMAS

Now released for showing throughout the country.

Available to employee groups, technical societies, engineering schools, and other organizations.

This 35-minute, color and sound film tells the story of the tremendous importance of these "biggest little things" in Industry. Of the research and manufacturing facilities employed in this highly-specialized business of sealing the joints in vital equipment against the effects of high temperatures, pressures, corrosion and other service conditions.

Write for full information.

GOETZE GASKET & PACKING CO., Inc.
17 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY

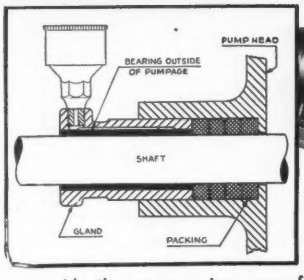
Goetze for GASKETS

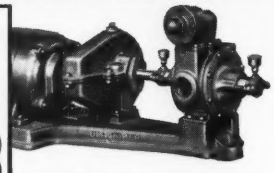
"America's Oldest and Largest Industrial Gasket Manufacturer"

A PUMP IS NO BETTER THAN IT'S BEARINGS

take a look at

BLACKMER ROTARIES

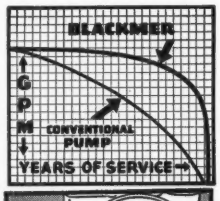




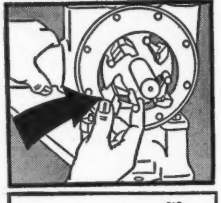
Double-bearings eliminate shaft-whip and provide exceptional rigidity. The bearings are located on both sides of the rotor, outside the pump casing, away from the pumpage and are protected by the packing.

OTHER IMPORTANT FEATURES

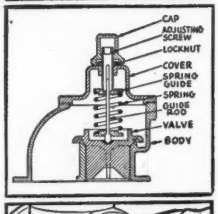
The curve shows the sustained capacity of Blackmer pumps. 20 years of service is not unusual. Compare this with a conventional type rotary.



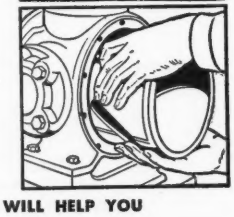
When the "buckets" (swinging vanes) finally wear out, this simple replacement restores the pump to normal capacity. It's a 20-minute job.



Built-in relief valves will by-pass the entire capacity of the pump without shock or end-thrust. This gives positive protection to the pump. Valve operation is quiet —no chatter.



For tough jobs, handling corrosive or mildly abrasive liquids, Blackmer pumps are furnished with removable liners. When finally worn out, the liner is replaced and the pump restored to normal capacity. This saves the cost of a new pump.



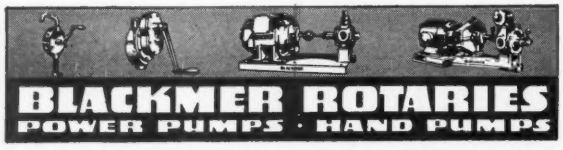
BLACKMER ECONOMY WILL HELP YOU MEET POST-WAR COMPETITIVE PRICES

POWER PUMPS
5 to 750 GPM. Pressures to 300 psi.

HAND PUMPS
1½ to 25 GPM. Pressures to 125 psi. 56 models

Write for new Bulletin No. 304—Facts about Rotary Pumps.

BLACKMER PUMP COMPANY, 2017 Century Avenue, Grand Rapids 9, Michigan



Power Plant Construction News

Alaska, Ketchikan—Board of Public Utilities, 334 Front St., plans early call for bids for extensions in municipal hydroelectric generating station, to include building extension, installation of additional equipment, two power substations, and extensions in transmission and distribution lines. Cost about $400,000, of which $125,000 is being secured through Federal aid, and remainder furnished by city.

Calif., Los Alamitos—Navy Department, Washington, D. C., has authorized expansion and improvements in naval air station at Los Alamitos, including new hangars, shops and other structures, with electric power equipment and mechanical facilities. Also will make extensions in power substation, electrical distribution lines and service connections. Cost estimated approximately $1,300,000. Public Works Office, 11th Naval District, foot of Broadway, San Diego, Calif., will be in charge.

Conn., Middletown—Russell Mfg. Co., 88 East Elm St., manufacturer of webbings, tapes and other textile products, plans installation of electric power equipment in new one-story addition, about 100 x 100 ft. Cost reported over $75,000, with machinery. Application will be made for a priority rating. Leo F. Caproni, 1221 Chapel St., New Haven, Conn., is architect and engineer.

Ill., Chicago—Cribben & Sexton Co., 700 North Sacramento Ave., manufacturer of gas ranges, parts, etc., plans installation of electric power equipment in new one-story addition, about 120 x 175 ft. Cost estimated over $100,000. Project has a priority rating and work is scheduled to begin at early date. Arthur Swanson & Associates, 540 North Michigan Ave., are architects.

Iowa, Klemme—Federated Cooperative Power Association, Hampton, Iowa, plans new generating station in vicinity of Klemme. Proposed to use Diesel engine-generator units and accessories. Also will increase capacity of power substation at Allison, Iowa, with installation of transformers and auxiliary equipment. Financing in amount of $125,000 has been arranged through Federal aid and additional funds are available through a former appropriation, exact amount not announced. Work is scheduled to begin soon.

Iowa, Pella—Municipal Power and Light Department has plans under way for installation of coal-handling system at municipal power plant. No estimate of cost announced. Proposed to ask bids soon. Brown Engineering Co., Valley Bank Bldg., Des Moines, Iowa, is consulting engineer.

Iowa, Sioux City—Fairmont Creamery Co., 3rd St. and Wesley Way, plans installation of electric power equipment in proposed new one-story addition, reported to cost over $200,000, with machinery. Application has been made for a priority rating, with work scheduled to begin as soon as secured. A. D. Bland is general manager.

Mich., Flint—State Department of Institutions, Lansing, has plans under way for new power plant at Michigan State School for Deaf, Flint, construction to be carried in conjunction with erection of other buildings at institution, including improvements in certain existing structures. Estimates of cost are being made. It is understood that project will be a postwar development. H. Augustus O'Dell, Hewlett & Luckenbach, Dime Bank Bldg., Detroit, Mich., are architects.

Mich., Lansing—Motor Wheel Co., 735 East Saginaw St., manufacturer of automobile wheels, heavy metal stampings, etc., plans installation of electric power equipment in new one-story addition, estimated to cost about $375,000. Project has a priority rating and work is scheduled to be carried out at once.

Minn., Hopkins—Village Council plans installation of new steel water tower for municipal water system. Ralph D. Thomas & Associates, 1200 2nd Ave. South, Minneapolis, Minn., consulting engineers, will determine required capacity, estimates of cost, etc.

Minn., Sebeka—Land O'Lakes Creameries, Inc., 2201 Kennedy St., N. E., Minneapolis, Minn., plans boiler house at new milk dehydrating plant at Sebeka. Main building will be one and two-story, about 92 x 120 ft. Electric power equipment will be installed. Entire project will cost over $200,000, with machinery. Project has a priority rating and work on superstructure will begin soon. Max O. Buetow, 1931 University Ave., St. Paul, Minn., is architect.

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N. J., Newark—Celanese Corp. of America, 180 Madison Ave., New York, N. Y., plans installation of electric power equipment in new one and two-story addition, 55 x 200 ft, to plastic products plant at 290 Ferry St., Newark, reported to cost over $90,000, with machinery. Work will be placed under way soon. It is understood that project has a priority rating.

N. Y., New York (Long Island City)—War Department, Washington, D. C., has plans maturing for new one-story postoffice building at former Madison Square Garden Bowl, Long Island City, totaling 500,000 sq ft floor space, to be used jointly by Army Postal Service and Post Office Department. Electric power equipment and complete mechanical-handling facilities will be installed. A boiler plant will be installed for central-heating service. Cost estimated about $1,500,000. Alfred Hopkins & Associates, 415 Lexington Ave., New York, are architects. U. S. District Engineer Office, 120 Wall St., New York, is in charge.

N. C., Winston-Salem—National Carbon Co., Inc., Carbon Products Division, Chatham Rd., manufacturer of carbon and graphite products, plans installation of electric power equipment in new additions to local plant, reported to cost over $500,000, with machinery. Work is scheduled to begin soon. Project has a priority rating. Main offices are at 30 East 42nd St., New York, N. Y.

Ohio, Cincinnati—National Distillers Products Co., 7818 Wayne Avenue, now in production for commercial alcohol for Government, plans installation of electric power equipment in new two-story addition to distillery, reported to cost about $125,000. This is part of expansion program at plant to cost about $235,000, for which financing is being provided by Defense Plant Corp., Washington, D. C., Federal agency. Sanderson & Porter, 52 William St., New York, N. Y., are engineers. Main offices of company are at 120 Broadway, New York.

Ore., St. Johns—Portland General Electric Co., Electric Bldg., Portland, Ore., plans new submarine 11,000-v transmission line across Willamette River at St. Johns, near Portland. Application has been made for permission to War Department and work will be carried out as soon as granted.

Pa., Philadelphia—Publicker Commercial Alcohol Co., 1429 Walnut St., has contracted with Government for expansion in plant at Bigler St. and Delaware River, including machinery installation for increased output. Electric power equipment will be installed. Entire project will cost about $130,000, with financing in that amount by Defense Plant Corp., Washington, D. C., Federal agency. Work will be carried out at once.

Tenn., Millington—Bureau of Yards and Docks, Navy Department, Washington, D. C., has authorized new water treatment plant, with water tank, pumping equipment and other facilities at Millington Naval School, to cost about $125,000. Appropriation approved in that amount.

Wash., Bellingham—Bellingham Port Commission, Harry F. Isler, port manager, has plans under way for new cold storage and refrigerating plant on Squalicum port tract on waterfront. Cost about $150,000, with machinery. Application has been made for a priority rating.

Wash., Longview—Water Department, A. B. Labsap, superintendent, plans early call for bids for new filtration plant on Cowlitz River for municipal water system. Cost estimated about $125,000. Cunningham & Associates, Spalding Bldg., Portland, Ore., are consulting engineers.

W. Va., Nitro—American Viscose Corp., Delaware Trust Bldg., Wilmington, Del., manufacturer of viscose rayon products, plans expansion at branch mill at Nitro, including additional buildings and machinery for increase of about 12,000,000 lb per annum. Electric power equipment will be installed. Power house at plant will be enlarged, with equipment installation for increased capacity. Entire project is reported to cost over $2,000,000. Application will be made soon for a priority rating.

Wis., Cudahy—Cudlak Food Industries, Inc., care of C. J. Puetz, 3113 East Layton Ave., president, recently organized by Mr. Puetz and associates, plans new cold storage plant, with locker system, on local site, one-story, about 62 x 100 ft. Bids will be asked soon for refrigerating machinery, locker units and other facilities. Cost reported over $40,000. R. E. Oberst, 2659 North 27th St., Milwaukee, is architect.

Wis., Prairie du Chien—Wisconsin Cooperative Farm Supply Co., 18 South Thornton Ave., Madison, Wis., plans installation of electric power equipment in new one, two and three-story commercial fertilizer plant at Prairie du Chien. A boiler house is planned. Entire project is estimated to cost about $300,000. A priority rating is being secured. Toltz, King & Day, Inc., Pioneer Bldg., St. Paul, Minn., is architect and engineer. T. R. Noonan is manager.

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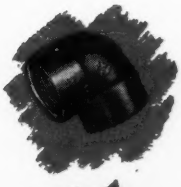

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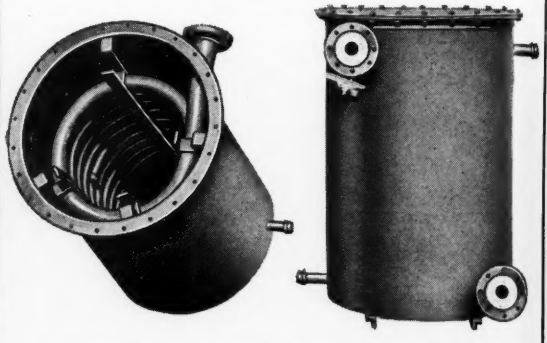

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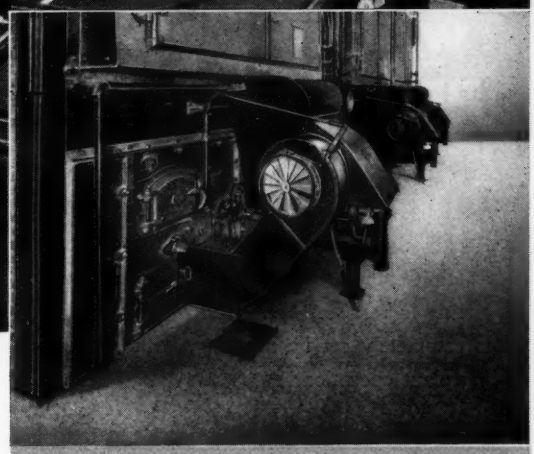

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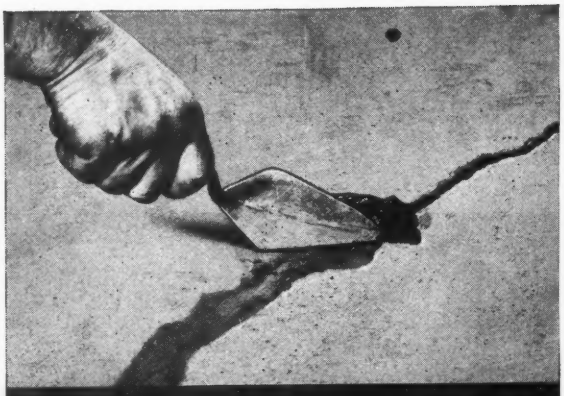

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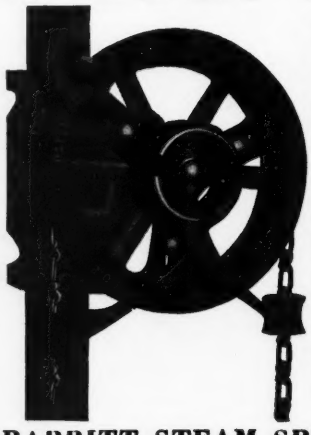

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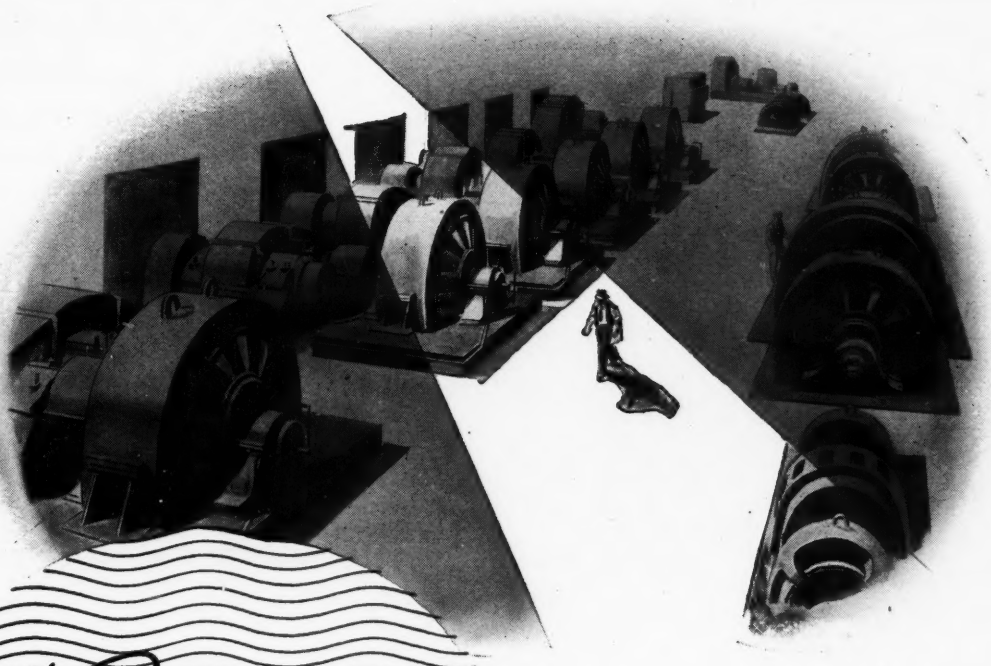

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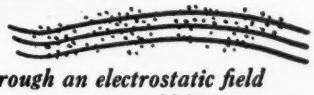

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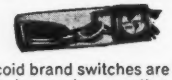

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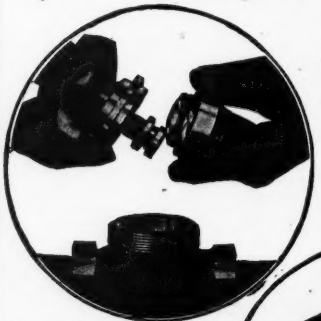

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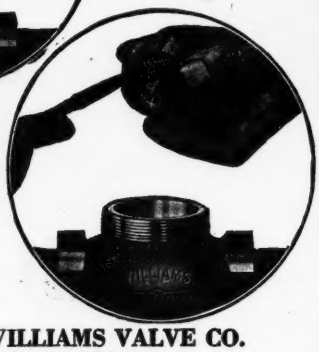

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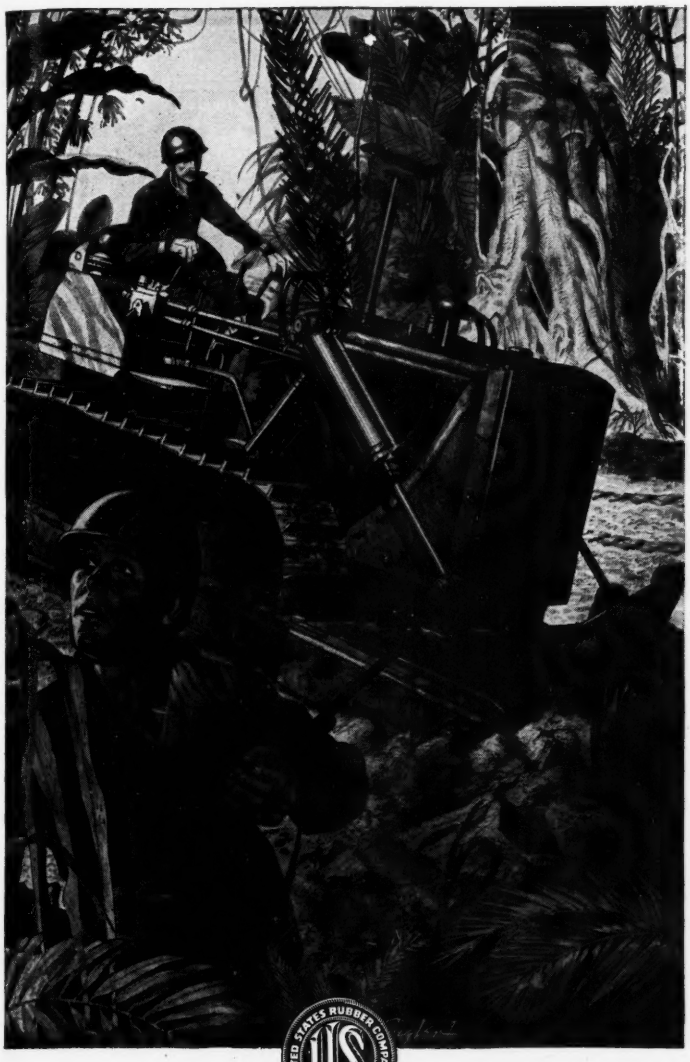

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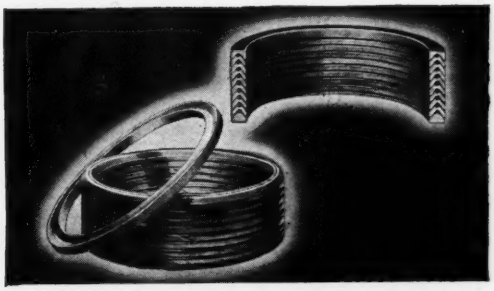

U. S. MATCHLESS PACKING SETS—Are now being delivered in huge quantities to "dozer" manufacturers, Army Engineers, Seabees. Molded to accurate sizes; special top and bottom rings for square or bevel stuffing boxes.

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WITH THE LATEST IN

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including the New

WESTPORT WELDED JOINT

FOR ALL PRESSURES AND TEMPERATURES

Complete penetration with smooth, sound welds providing streamline interior contour and *without* the use of Backing Rings which may obstruct flow or sacrifice pipe wall strength with unnecessary machining. Write for bulletin describing in detail advantages of Westport Welded Joint.

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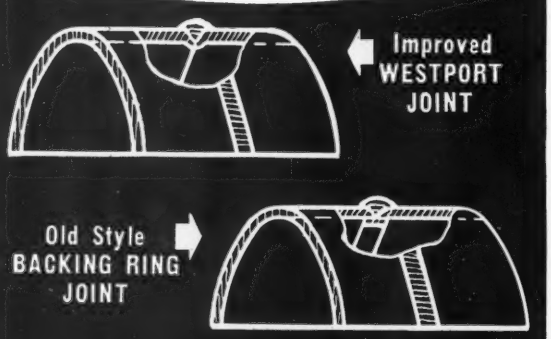

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Specialists in Alloy Piping

Tops for Safety *Sure to Shut Off Tight*

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SUPER TRY COCKS

FOR ALL TYPES OF BOILERS

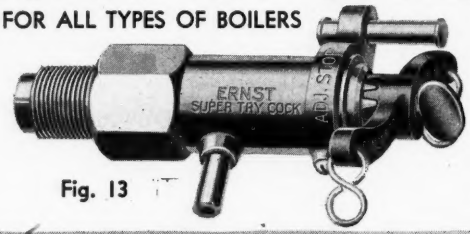
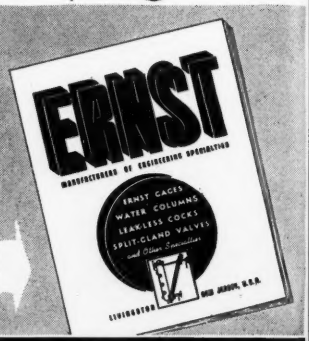


Fig. 13

TO HELP YOU KEEP BOILERS SAFE . . .

FREE

BOILER SPECIALTY CATALOG No. 45



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LIVINGSTON, NEW JERSEY

LUBRICANTS for

TODAY'S CONDITIONS *and*

TOMORROW'S NEED

The development and improvement of ALBANY GREASE (the tallow lubricant) through three generations has brought the name of Adam Cook's Sons, Inc., to the front in Industrial Lubrication.

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Because of the steady improvement of the ALBANY LINE, it kept pace with the changing methods in Industry; better lubricants were fabricated to meet the increased production speeds. TODAY, the up-to-date ALBANY LINE GIVES THE JOBBER A COMPLETE, EASILY SOLD ASSORTMENT OF LUBRICANTS FOR MODERN INDUSTRY.

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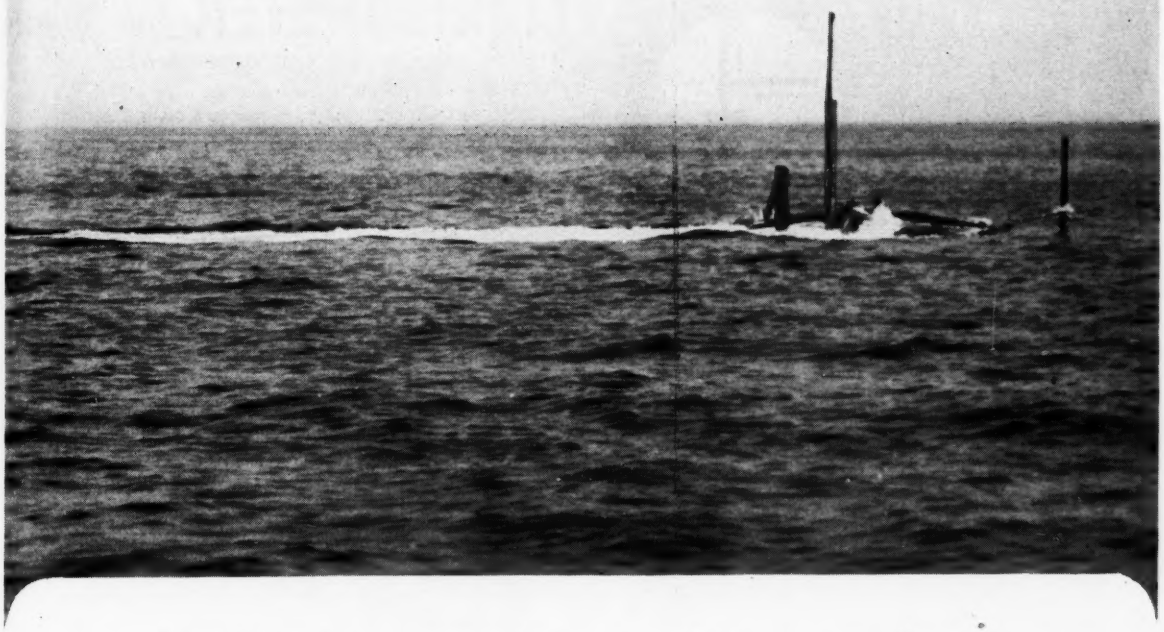
Send for the new catalogue insert sheets (recommendation chart included), the new circular and price list. The new literature will help you increase your sales.

ADAM COOK'S SONS, INC.

LINDEN, N. J.

HIDDEN *Water Hazards*



● Hidden Hazards . . . sponsored by Uncle Sam . . . are showing up in many waters with devastating results for the enemy.

Hidden Hazards . . . sponsored by Objectionable Dissolved Minerals or Chemical Instability . . . are showing up in many water supplies with just as devastating results for plant equipment and manufacturing processes.

In the latter case action is far from spectacular . . . that's why the Hazards are Hidden . . . but, in either case . . . the end results are the same.

Water that is conditioned to remove objectionable minerals, hardness, corrosion, oil, suspended matter, etc. will protect your production schedules, safeguard irreplaceable power plant equipment, save precious fuel and reduce labor costs.

The power plant, so vital to the war effort, can have the protection of Infilco equipment for boiler or evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, etc. . . . as well as Infilco chemical feeders and trade waste treating equipment. You are invited to make use of Infilco's 49 years' experience in these allied fields. Call on our Engineering Staff. There is no obligation.

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ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
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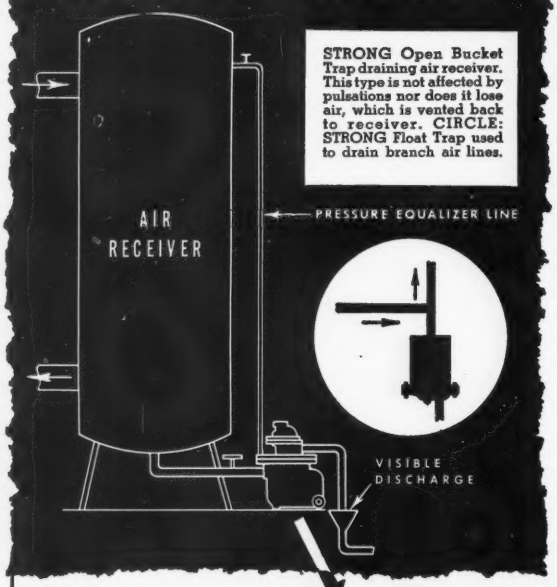
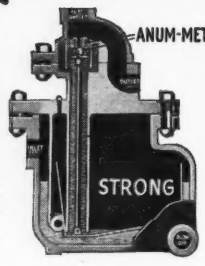
DRAIN RECEIVERS WITH NO AIR LOSS



STRONG Open Bucket Trap draining air receiver. This type is not affected by pulsations nor does it lose air, which is vented back to receiver. CIRCLE: STRONG Float Trap used to drain branch air lines.

Reciprocating compressors cause pressure surges in air receivers. These pulsations tend to "bounce" buckets of inverted bucket traps, resulting in excessive wear of parts, continual discharge and loss of air.

STRONG Open Bucket Traps are not affected by such pulsations. Only the weight of condensate in the bucket causes them to discharge. No air is lost during discharge, and air displaced from the trap by incoming condensate is vented back to the receiver.



This hook-up also is used for draining gas receivers and accumulators. Where liquids other than water are handled, special traps are furnished.

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Completeness of the STRONG lines enable us to recommend exactly the type and size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—forged, fabricated (welded), cast and semi-steel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland, Ohio.

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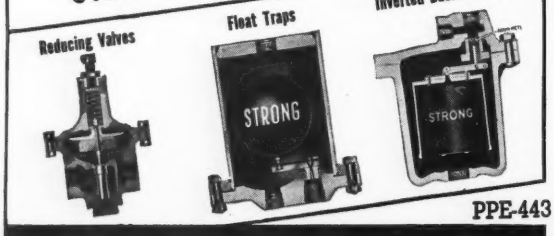
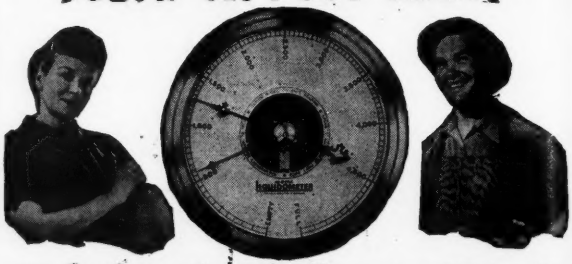


PPE-443

STRONG
STEAM SPECIALTIES

TODAY OR POST-WAR!



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LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.
No pumps, valves, or auxiliary units needed to read them.
Models available for either remote or direct readings.
Accuracy unaffected by specific gravity of tank liquid.
Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

THE LIQUIDOMETER CORP.
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SOME methods of water softening remove calcium and magnesium bicarbonate and calcium and magnesium sulphate, but do not remove certain insoluble salts which accumulate and form a hard scale.

Other methods take out the insoluble salts but introduce an equivalent amount of sodium salts. This may lead to pitting and alkali embrittlement.

In both cases, the safe rule is "Finish with Magic". It provides a colloidal film of protection on the surface of boiler metal that checks scale formation—guards against corrosion and pitting.

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Established 1904

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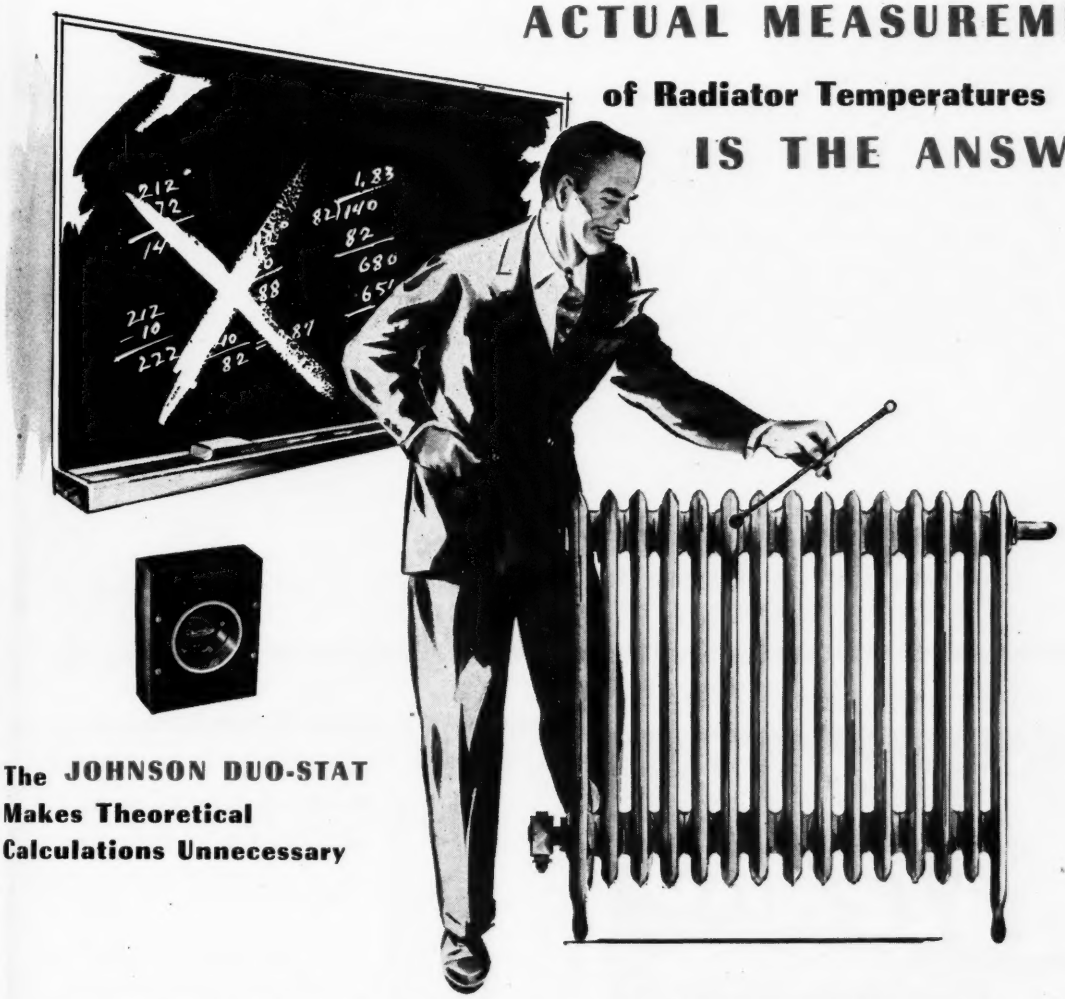
For MAXIMUM Fuel Conservation—

ACTUAL MEASUREMENT

of Radiator Temperatures

IS THE ANSWER!



The **JOHNSON DUO-STAT** Makes Theoretical Calculations Unnecessary

The Johnson Duo-Stat *actually measures* the temperature of the heating system and adjusts that temperature as demanded by outdoor weather conditions. Radiators are full of steam during coldest weather. However, for the greater portion of the heating season, they are only partially filled. This inevitably results in *greatest fuel economy!*

One Duo-Stat may control the temperature of an entire building at the street steam main or automatic firing device. In larger buildings, Johnson Zone Control provides a separate Duo-Stat to operate the valve in each branch main. Installed in existing or new buildings with equal facility . . . Hundreds of Duo-Stats are in successful operation. Actual records show fuel savings of 25% and more. Ask a Johnson engineer from a nearby branch office, or your heating contractor, to make a survey and recommendations. Explanatory bulletins will be sent, without obligation, upon request.

BUY MORE BONDS!

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Fuel-Saving Starts With CONTROL

Automatic TEMPERATURE AND AIR CONDITIONING *Control*

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Is there anything the Army Engineers can't do?

JACK OF ALL TRADES ...AND *MASTER* TOO!

One of the most versatile—yet unerringly accurate reducing valves. Regulates oil, gas, steam, water or air under constant or pulsating initial pressures up to 300 lbs. The reduced pressure range is from 1 lb. to 75% of inlet, not exceeding 125 lbs. Pressure setting is easily adjusted. Inner valve construction assures proper seating and minimum pressure drop at full valve opening. Beveled discs are standard, with other types available.

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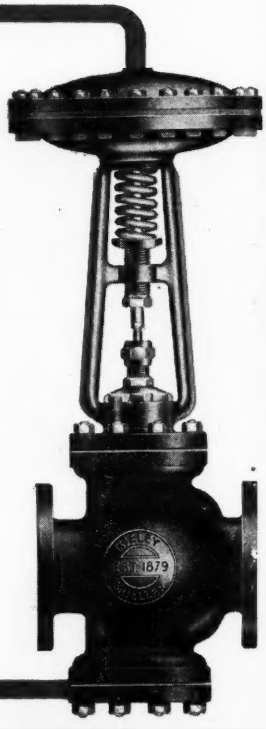
TYPES	SIZE, IN.	BODY MATERIALS
422	½" to 3" ½" to ¾" 1" to 12	Semi-steel or Cast-steel Bronze Standard or X Heavy Semi-steel or Series 15, 30 or 40 Cast-steel
423	½" to 2"	Bronze or Cast-steel
425	2" to 8"	Semi-steel or Cast-steel



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MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
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STOP LEAKS Instantly!

Damp-Proof Basements

Leaks, water seepage in concrete wells can be stopped instantly—permanently, with FLEXTITE. This amazing material actually seals against water pressure. Will convert wet basements into bone-dry useful space. Efficient as a plaster coat for waterproofing and dampproofing. Used in elevator pits, tunnels, dams, concrete water tanks, retaining walls. In reconstruction work, broken pillars and beams can be quickly restored, even reshaped, with FLEXTITE.

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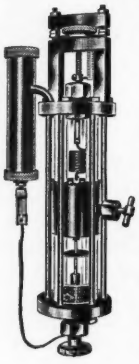

Mechanical Type

"An instrument for measuring the differential pulsation amplitude across an orifice meter." It will determine whether or not accurate measurement may be obtained under the pulsation condition existing in the orifice meter installation.

If your orifice meters are located in pulsation areas, this instrument will determine if the conditions are such that accurate measurements may be obtained.

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METAL and ASBESTOS

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Gaskets are cheap . . . until they fail in service, and then they're the most expensive item in the installation. So it's good insurance to know your gaskets and who makes them.

U. S. AJAX gaskets are produced by men who have over a quarter of a century of specialized gasket experience . . . men who have improved on gasket design and construction until there isn't a better gasket made for pressures from 10 psi to 3500 psi.

Here are the facts: AJAX gaskets are constructed of a single ply of metal, preformed in a U-shaped groove, and spiralwound from the inside to the outside. Between each metal ply there are inserted two parallel thicknesses of UGASCO Asbestos filler, one on either side of the U groove. A free air space . . . a "breather space" . . . between each thickness of filler assures that the gasket expands and contracts in relation to internal pressure change. AJAX Spiral Wound Gaskets are used wherever a sure seal is required in any pipe line or similar joint.

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● Industry had a faint heart the morning after Pearl Harbor was attacked. The question on all sides was: "What will America do for Rubber?"

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Industry is getting the rubber it needs, due entirely to that ingenuity, the like of which is known and practiced only by Americans. The United States is now definitely "over the hill" as far as the supply of rubber is concerned.

Quaker, with its progressive program has made quite an achievement in turning out Industrial Rubber Products. For years we have been experimenting with, and using, American-made (synthetic) rubber.

Our Laboratory technicians have developed so many applications where American-made rubber is definitely turning out products better suited for their particular task than when made from Crude.

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If there is a way to get it done—Quaker will do it!

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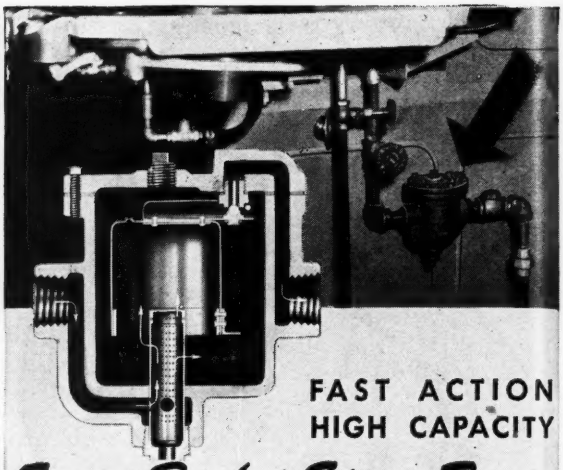

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HIGH CAPACITY

Sarco Bucket Steam Traps

This trap removes condensate from steam supply lines to pumps, engines, turbines and separators and is preferred by laundries, textile, and plastic industries. It can be adapted to the highest commercial steam pressures and temperatures and can be inspected without disturbing pipe connections. Integral strainer protects the mechanism. Sizes ½ to 2", pressures up to 900 lbs. Ask for Catalog No. 350.

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Roll-or-Flex Joints
for marine and industrial uses.

Ball Joints
for all types of transmission of steam, air, and liquids.

Rotary Joints
for transmission of steam, air, and liquids while in motion.

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for specialized industrial use.

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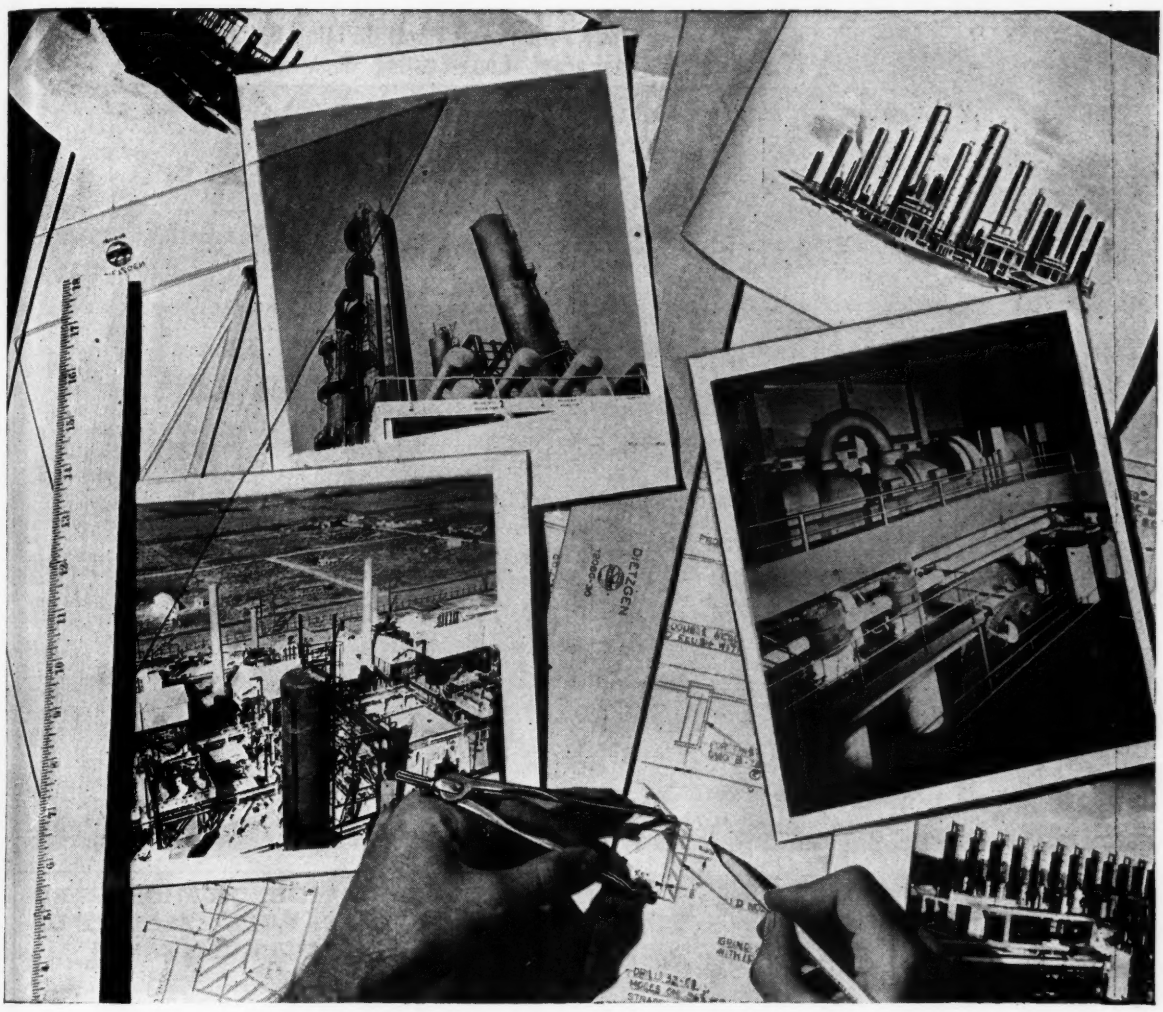

Alco has solved thousands of heat transfer problems...built nearly 20,000 units...is organized to handle any heat transfer equipment job completely

HEAT transfer equipment does a critical job—closely related to costs, safety and results.

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ALCO's large staff of heat transfer engineering specialists has a background of experience derived from solving literally thousands of heat transfer problems.

Nearly 20,000 heat transfer units, over 50,000,000 sq. ft. of heating surface, have been built in ALCO shops.

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Ask for a Connery Bid on those future Stacks or Breechings

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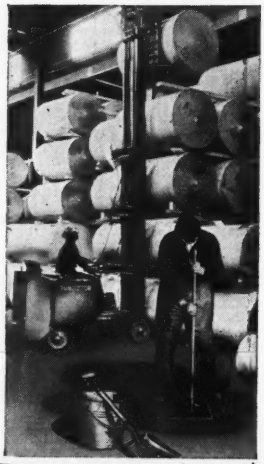
Takes Traffic Immediately

Now you can restore broken concrete to solid smoothness without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.



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Model 25

Manzel Force Feed Lubricators practically eliminate the human element from cylinder and bearing lubrication. They deliver oil to any lubrication point in accurately metered amounts exactly as needed. They never forget and the only attention they require is to maintain the supply of oil in the reservoir.

Feed on Manzel Lubricators is easily adjusted and very accurate. They start, stop, speed up and slow down with the engine.

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Squires Reducing Valve

Will maintain the constant pressure desired regardless of initial pressure. It is a dead end valve.

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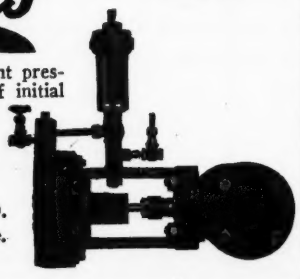

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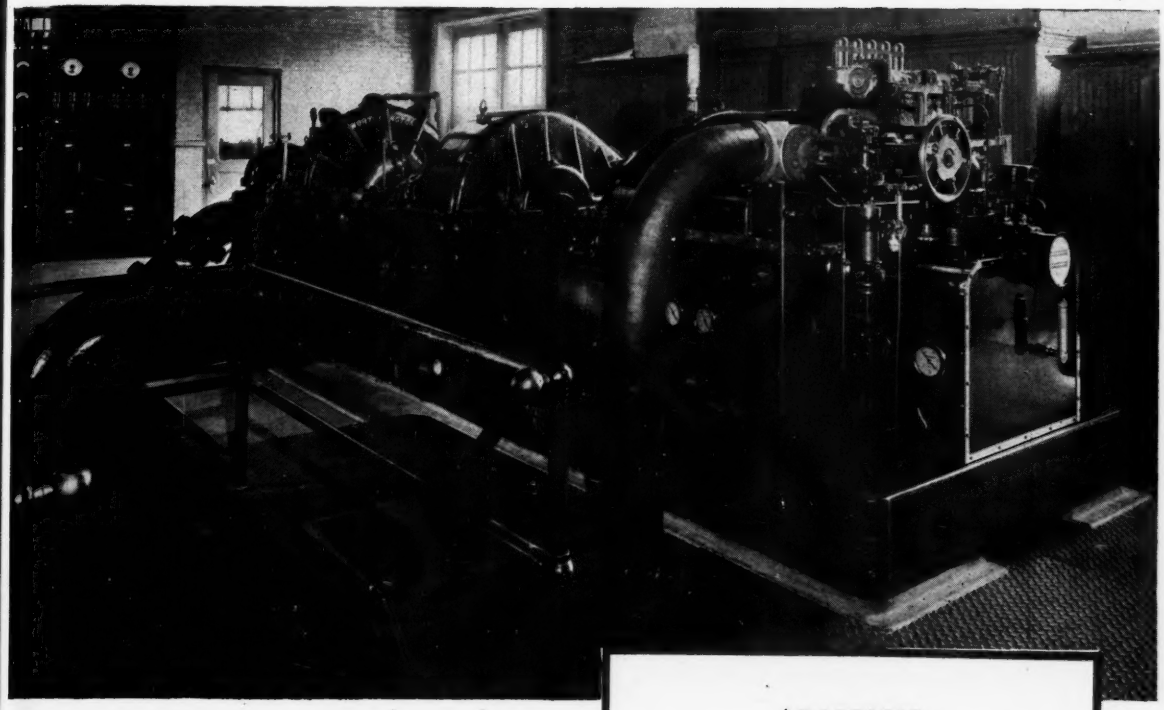

THIS Worthington-Moore turbine-driven centrifugal pumping unit was installed by the Water Works Department of the City of Lansing, Michigan, in 1941.

Turbine, gear, main pump, condenser and auxiliaries were engineered as a unit for maximum efficiency and uninterrupted service.

A Worthington-Moore condensing steam turbine, with double-helical reduction gear, drives a Worthington centrifugal pump capable of delivering 20 million gallons per day against discharge head of 200 feet.

Worthington—world's largest manufacturer of pumps, with broad experience in steam power equipment – combined with Moore's years of turbine engineering, can build the same year-in, year-out, trouble-free service into *your* Worthington-Moore steam turbines. Write us. Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, N. Y.

ADAPTABLE

TO HIGHER STEAM PRESSURES

Now operating on steam at 160 lbs. pressure, exhausting to 29" vacuum, the construction of Lansing's Worthington-Moore turbine is suitable for future steam conditions of 400 lbs. pressure and 750°F. total temperature. Automatic nozzle control permits greatest efficiency at reduced pumping rates.

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY
MOORE STEAM TURBINE DIVISION, WELLSVILLE, NEW YORK

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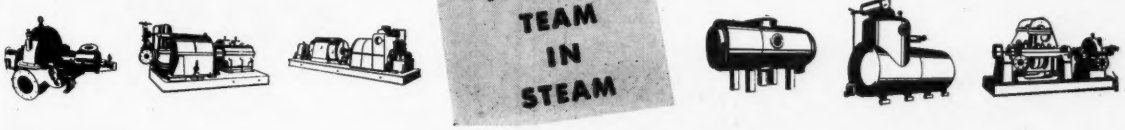

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	FOR STEAM, AIR AND GAS *ALSO RECOMMENDED FOR WATER AND OIL											FOR WATER			FOR GAS	
REGULATOR No.	2*	8	13	14*	15	16*	18*	19*	26*	27*	49	49*	49S*	17	21	48	9	29
MAXIMUM INITIAL PRESSURE	800	1500	400	400	200	400	250	250	125	125	400	1000	1500	250	125	400	250	250
MINIMUM REDUCED PRESSURE	- 1	0	½	0	0	0	1	1	1	1	1	0	1	0	½	10	½	¾
MAXIMUM REDUCED PRESSURE	125	300	100	200	30	125	1	1	1	1	15	300	100	300	60	200	100	100
FOR DEAD END SERVICE	✓		✓				✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
DIAPHRAGM ACTUATED—Brass fitting			✓	✓	✓	✓	✓	✓	✓	✓					✓			
PISTON ACTUATED—Direct Acting	✓										✓	✓	✓	✓		✓	•	
AUXILIARY PILOT CONTROL		✓					•	✓	✓	✓	✓	✓	✓		✓	✓		✓
SPRING LOADED			✓	✓										✓			✓	✓
WEIGHT LOADED	✓	✓			✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
SERVICE: GENERAL SERVICE	✓	✓		✓	✓	✓					✓	✓	✓				✓	✓
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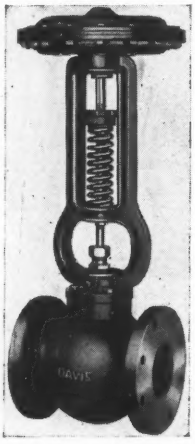
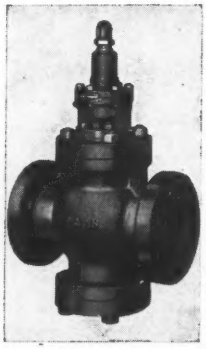


Above—No. 14. Direct connected spring loaded regulator. For steam, air, gas, water, oil. For pressures to 400 psi. For reduced pressures 0 to 200 lbs.



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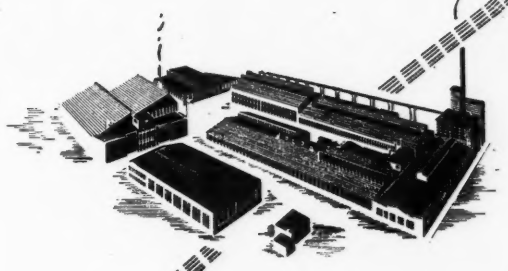

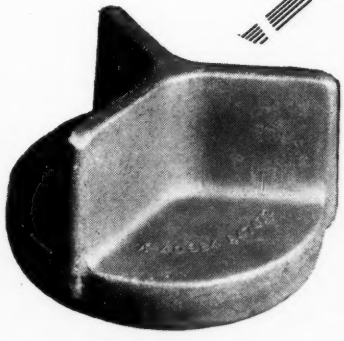

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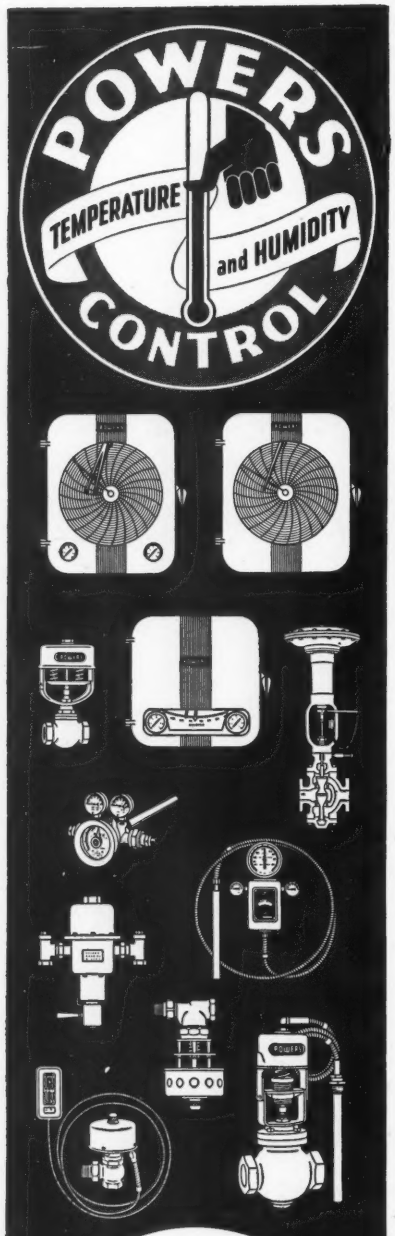

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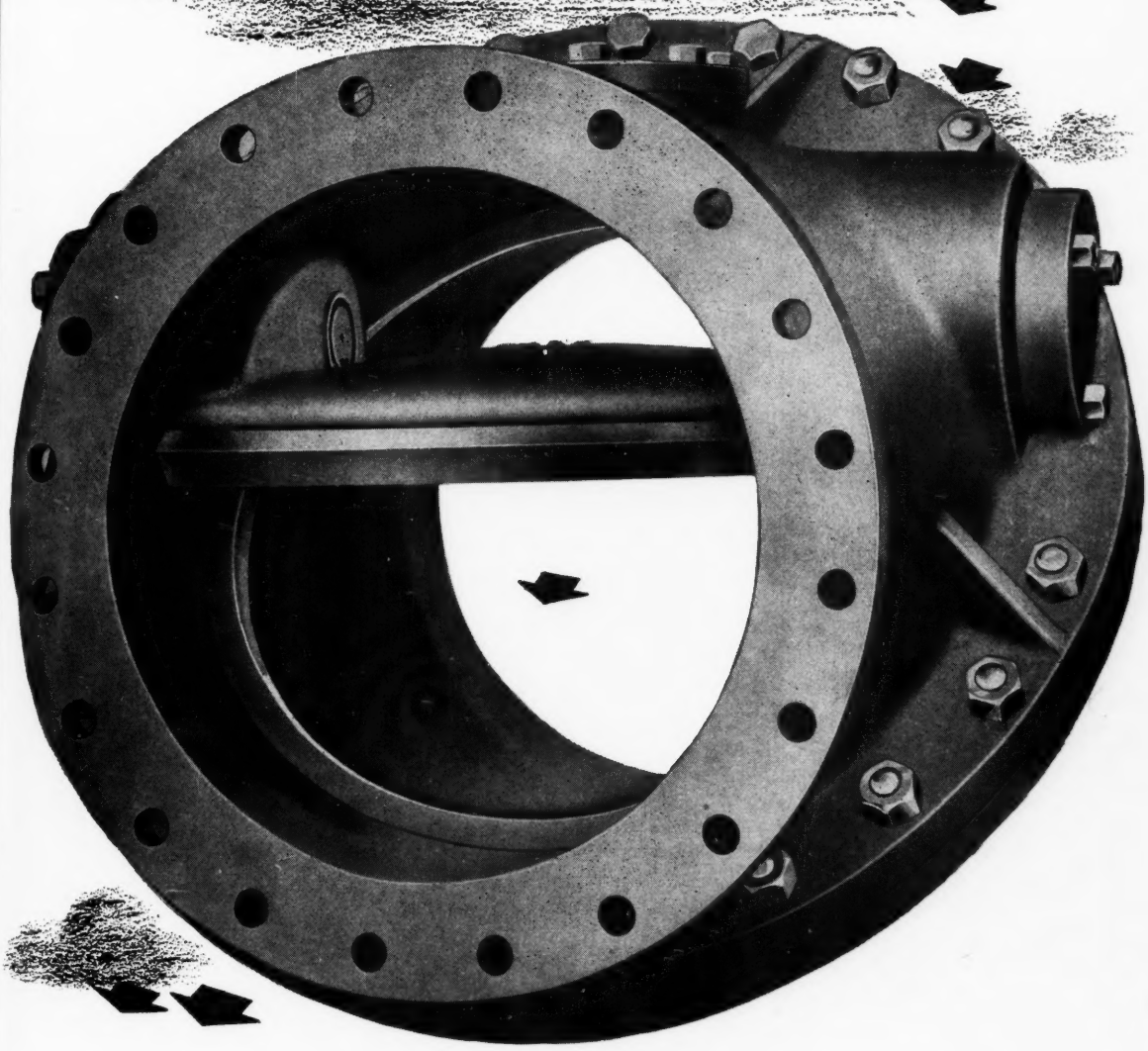

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